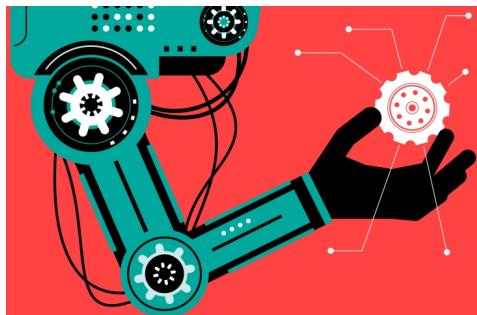


# Instituto Tecnológico de Estudios Superiores de Monterrey

## Applied Robotics



### Collaborative Robots - "Washerbot"

#### Team Members:

- Stepanhie Denisse Benitez Cabrera A00820320
- Hector Javier Pequeño Chairez A01246364

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#### Abstract

Will Robotics change the world? They already are. Along the course we learned not only the importance of robotics but to calculate the movements of the arms of a robot from scratch, we also learned that humans are so used to robots doing daily tasks for them they don't even realize they are robots. Robotics is not only a machine with a face as we see in the movies, robotics is the branch of technology that deals with the design, operation and application of robots. Right now all modern technology is designed to bring the world to you. A mind and a hand where it's needed while you sit safely at home and run the show. What we look for with this project and with everything we were taught in this class is for robots to change our lives not only in the future but to expand them, to make our lives easier.

Along this document we will talk about a new project called "Maji" where our main point is to help optimize a process that is considered a main task for the kitchen globally. We will show the step by step process, explaining each part of the robot and how it was designed. We will be able to show the different positions that were used for the chore task to be completed, different papers of how robotics and projects like this have been applied and have changed the world and at last our conclusions of the course and the project.

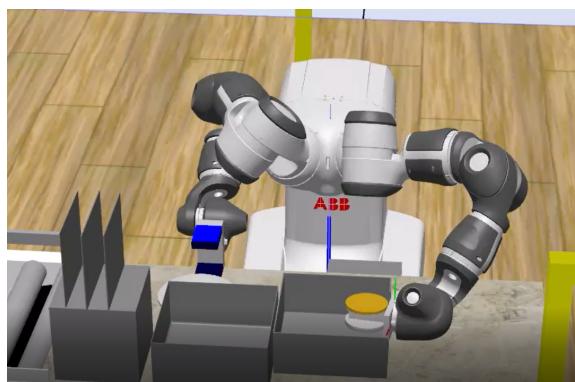
#### Project Proposal - Introduction

Washing dishes. We can all relate to this task from when we were young to our present days. Along the years doing this task has become more and more important around the world because it's not only safe for our health to eat out food in clean dishes but it is also know that

if we keep clean our dishes and we recycle and keep them the most we can, we can improve Earth's health and climate change by not contaminating. Now that we know that it's an important chore we can also agree sometimes we don't feel like washing dishes, and in places like restaurants were dishes are really important and they have to wash them as fast as they can, it would be very useful to have a huge help to make this process faster, cleaner and precise. That is why our project proposal is our robot called "Maji, the dish-washer robot". Our robot is fully capable of receiving a dish, carrying it, soaking it in water, cleaning it with soap and then drying it, everything in just 15 seconds. It will be a better use for restaurants because the process is faster and they could save budget by having one robot instead of 5 people trying to wash the dishes extra fast and buyings a thousand of them, because they have to make sure they never run out of dishes. Basically Maji would be saving time and money to restaurants, industrial places that have their own kitchen for their workers, hotels, and they can also be for personal use in your kitchen. You may be worried a robot is going to steal your job, and we get that. But, after all, automation is inevitable and you may be more likely to work alongside our robot in the near future than have it replace you.

### **Step by Step Process**

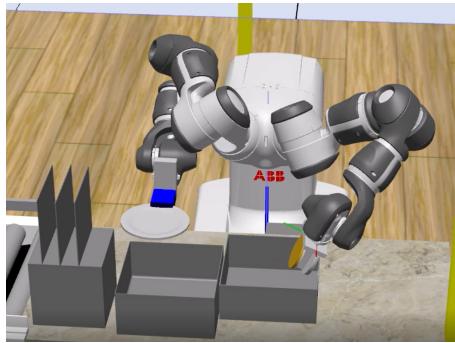
#### **Initial State**



The plate comes from the band.

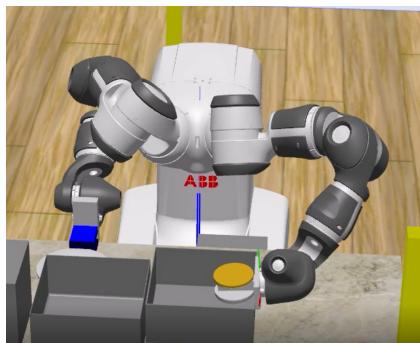
#### **1. First step: Grabbing the dish**

Our first step consists of the robot (Maji) to take the plate from where it is positioned.



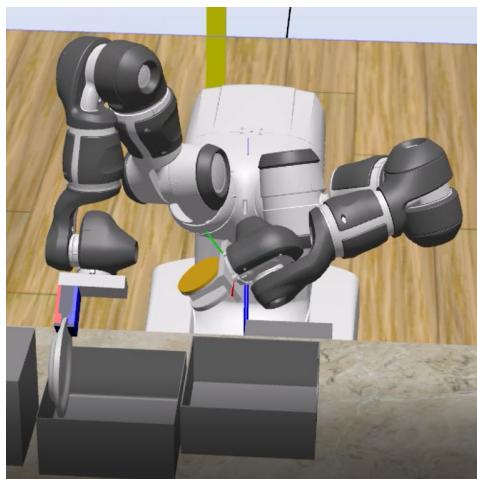
## 2. Second step: Carrying the dish

The plate should be carried by Maji and prepared for it to be soaked in water, while the left arm is diving on soap.



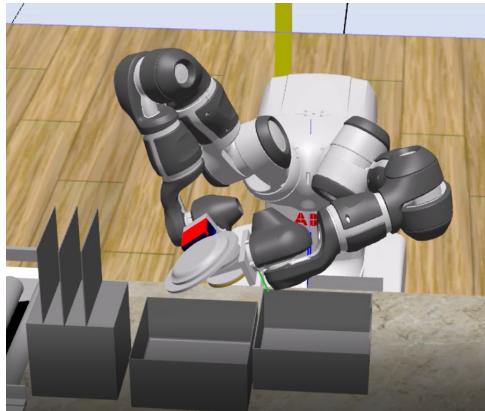
## 3. Third step: Soaking the dish in water

After Maji carries the dish and positions it over the water container, the dish is soaked into water and prepared for it to be washed with soap.



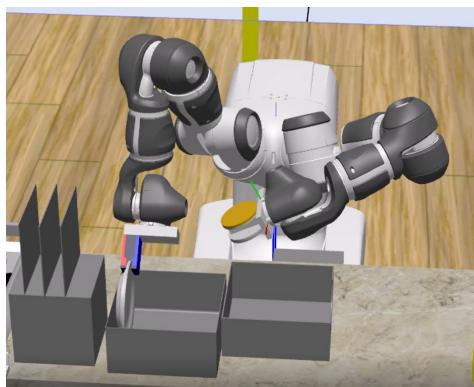
## 4. Fourth step: Wash the plate

Now with the left arm tool covered in soap we can wash the plate.



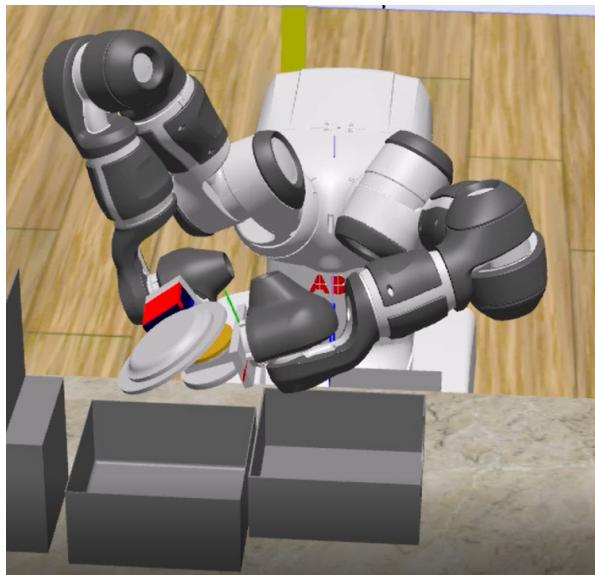
### 5. Fifth Step: Again, soaking the dish in water

After Maji carries the dish and positions it over the water container, the dish is soaked into water and prepared for it to be dried.



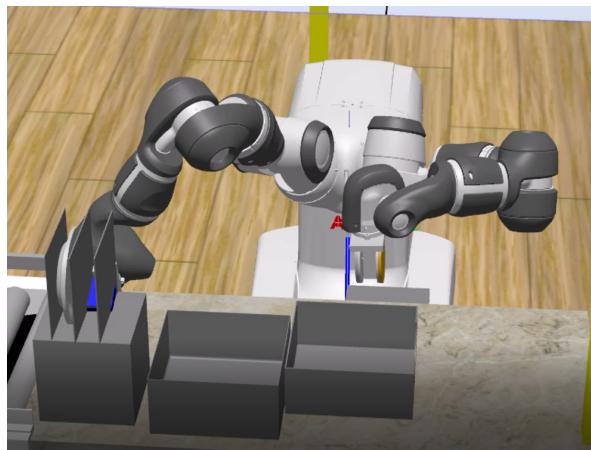
### 6. Sixth step: Dry the plate

With the other material we dry the plate. Linen.



### 7. Last step: Store the plate.

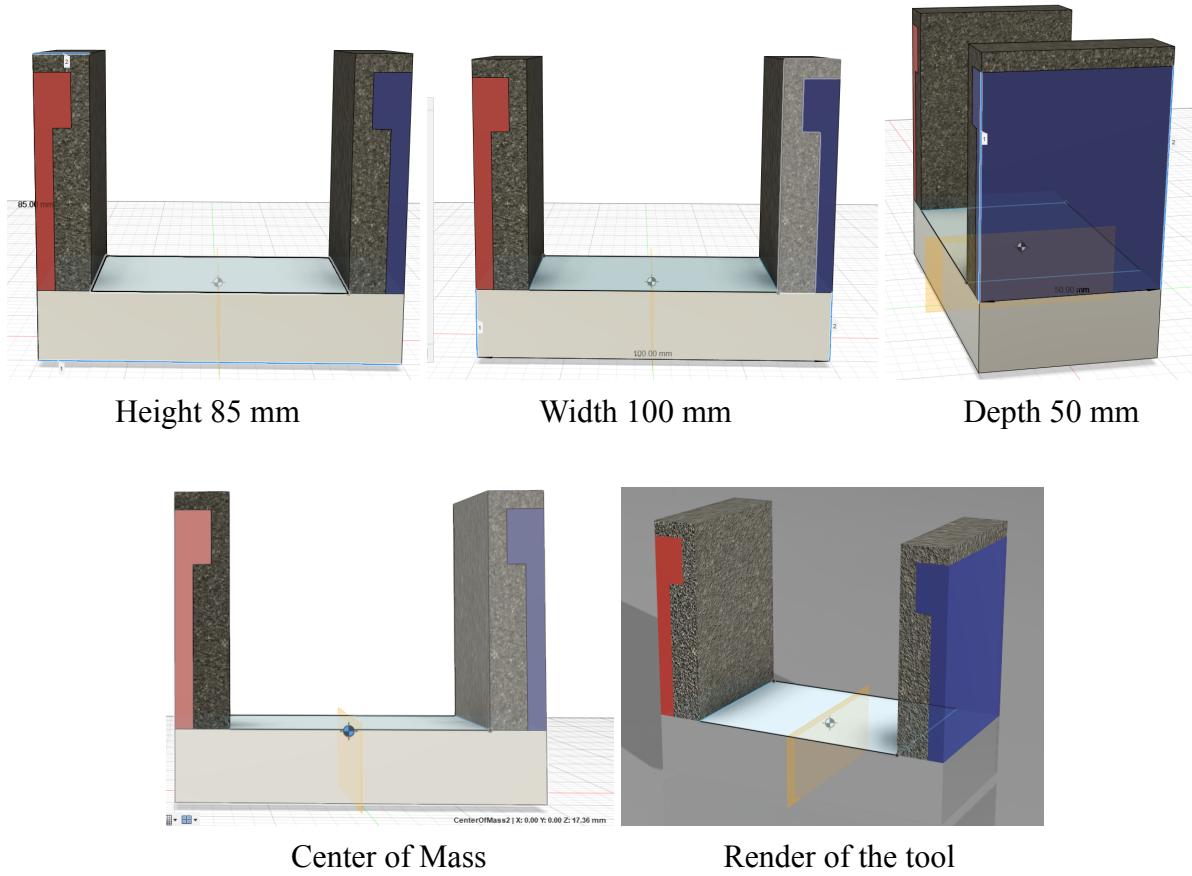
Store plate in the gabinet, and go back to the initial position.



## Designed tools

To develop the arms of the Washerbot, we decided to use two different arms, one of them is going to pick a plate while the other one is cleaning the plate, rinsing the plate and finally drying the plate.

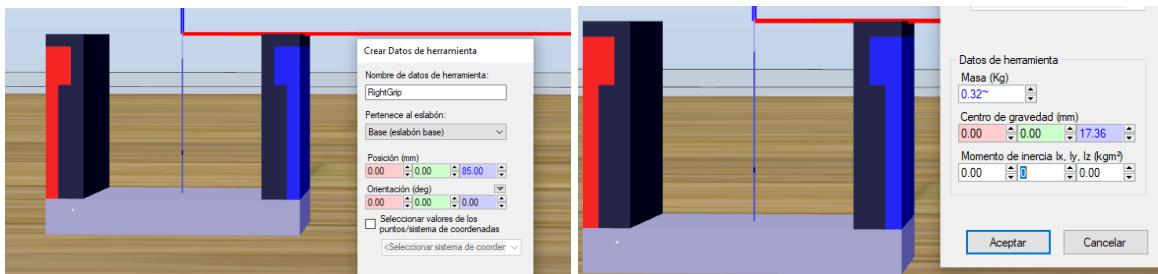
For this reason the ***right tool*** is a grip, to take the plate.



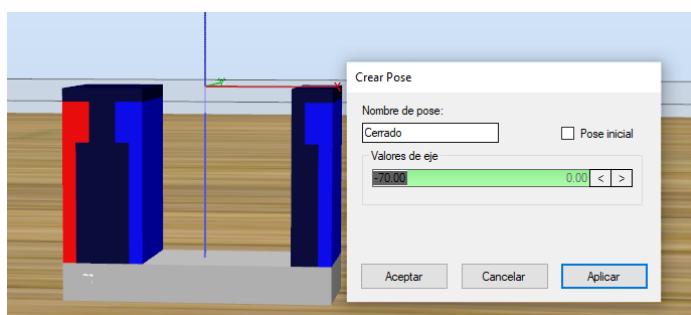
The tool has a **weight of 323.67 g**, an area of  $50900.00 \text{ mm}^2$  and a volume of  $1.975\text{E}+05 \text{ mm}^3$ , **Center of mass at the coordinates (0.00,0.00,17.36) mm** then the materials are the following:

- Aluminum 6061, Welded: Main construct material of the tool.
- Laminate, Blue, Matte: Decoration for the right part of the grip.
- Laminate, Red, Matte: Decoration for the left part of the grip.
- Polyurethane Foam: Material that protects the plates from the grip when it is taken.

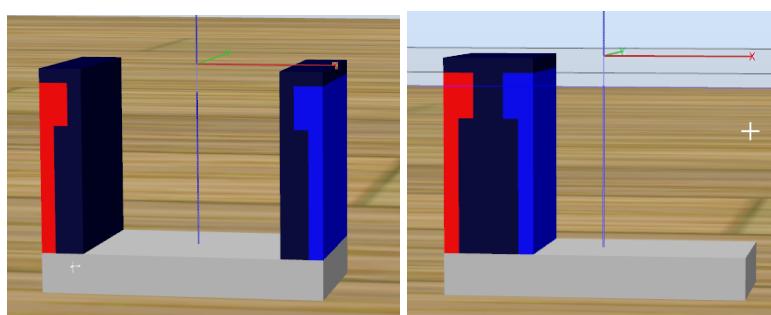
At RobotStudio, we delimit the following TCP (0.00,0.00, 85.00) mm, and the Center of Mass at (0.00,0.00,17.36mm) with a weight of approximately 0.32 Kg.



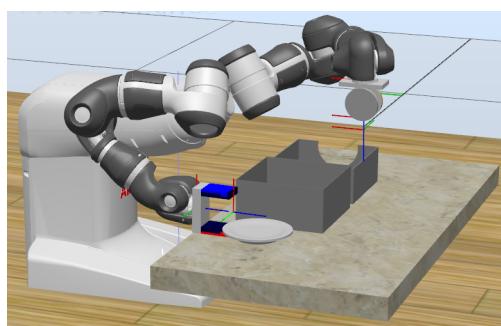
The movement is programmed with the objective of closing the grip, just moving one of the fingers, in this case the left side finger.



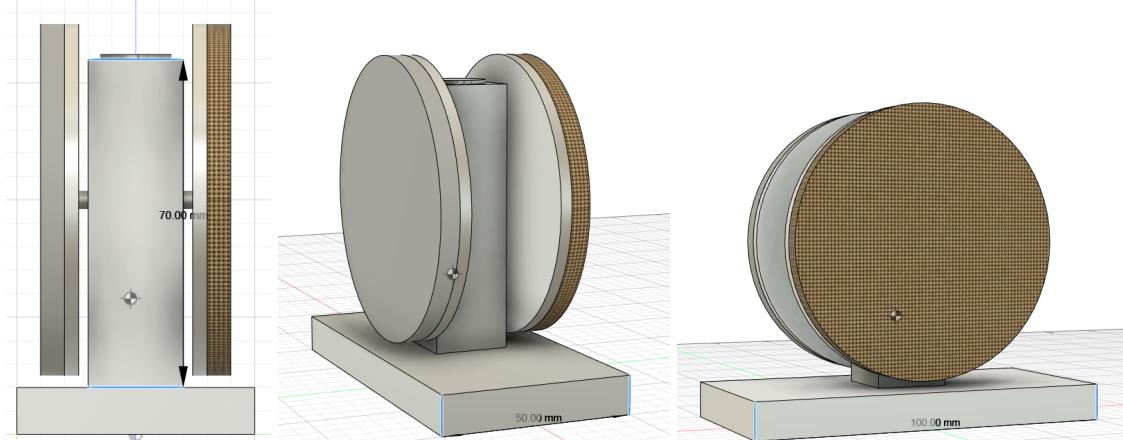
This is the tool with the open and closed grip.



Finally we have the robot with the right tool.



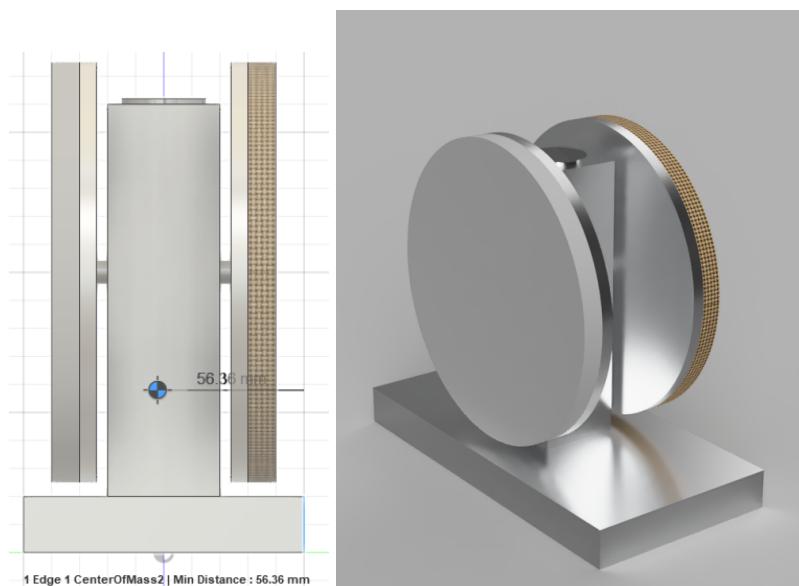
Now it is time for the ***Left tool***. This tool develops the task of drying and washing, for this reason we create a tool that does both of the tasks, one from 1 side and the other one is done by the other side, finally with the camera verify, if the plate is clean or not,..



Height 87 mm

Width 50 mm

Depth 100 mm



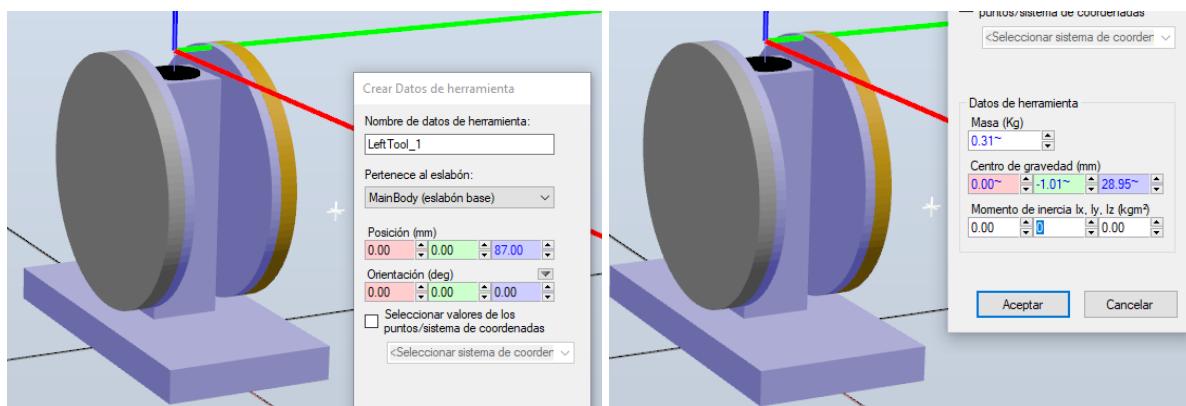
Center of Mass

Render

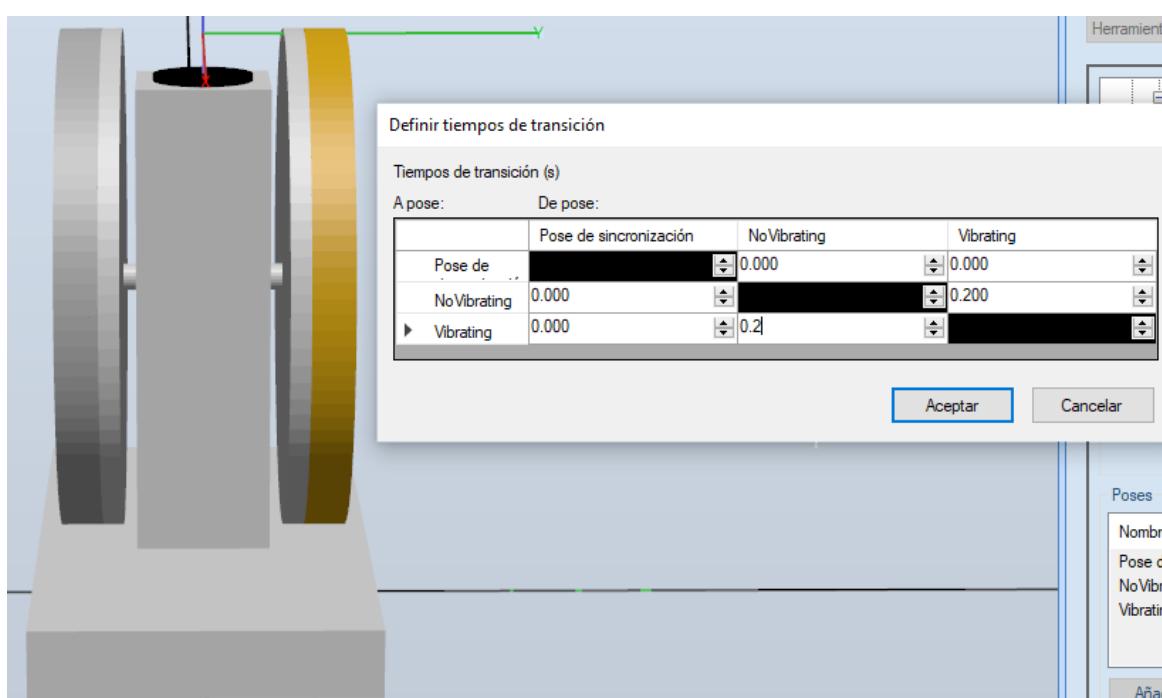
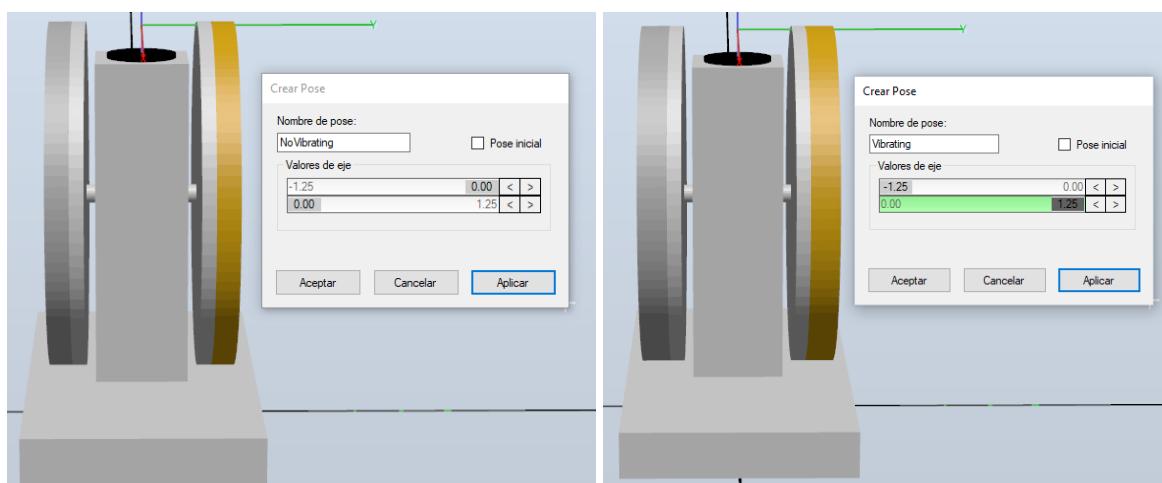
This second tool has a **weight of 306.618 g**, an area of  $58584.62 \text{ mm}^2$  and a volume of  $1.489\text{E}+05 \text{ mm}^3$ , **Center of mass at the coordinates (-1.246E-09, -1.009, 28.951) mm** then the materials are the following:

- Aluminum 6061, Welded: Main construct material of the tool.
- Linen, Beige: Material to dry the plates.
- Polyethylene, High Density: This material is the most efficient material for Dishwashing

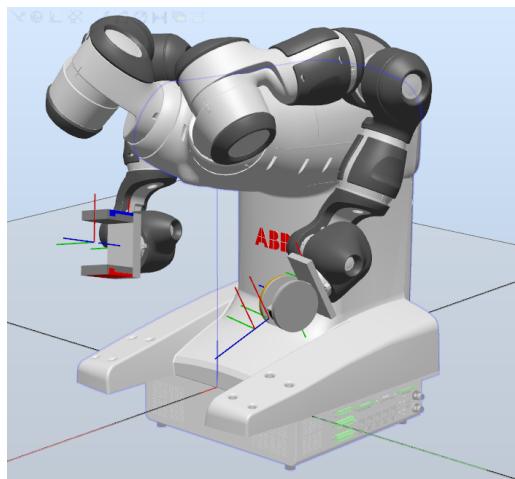
At RobotStudio, we delimit the TCP at **(0.00, 0.00, 87)** mm, and the Center of Mass at **(-1.246E-09, -1.009, 28.951) mm** with a weight of approximately .30618 Kg.



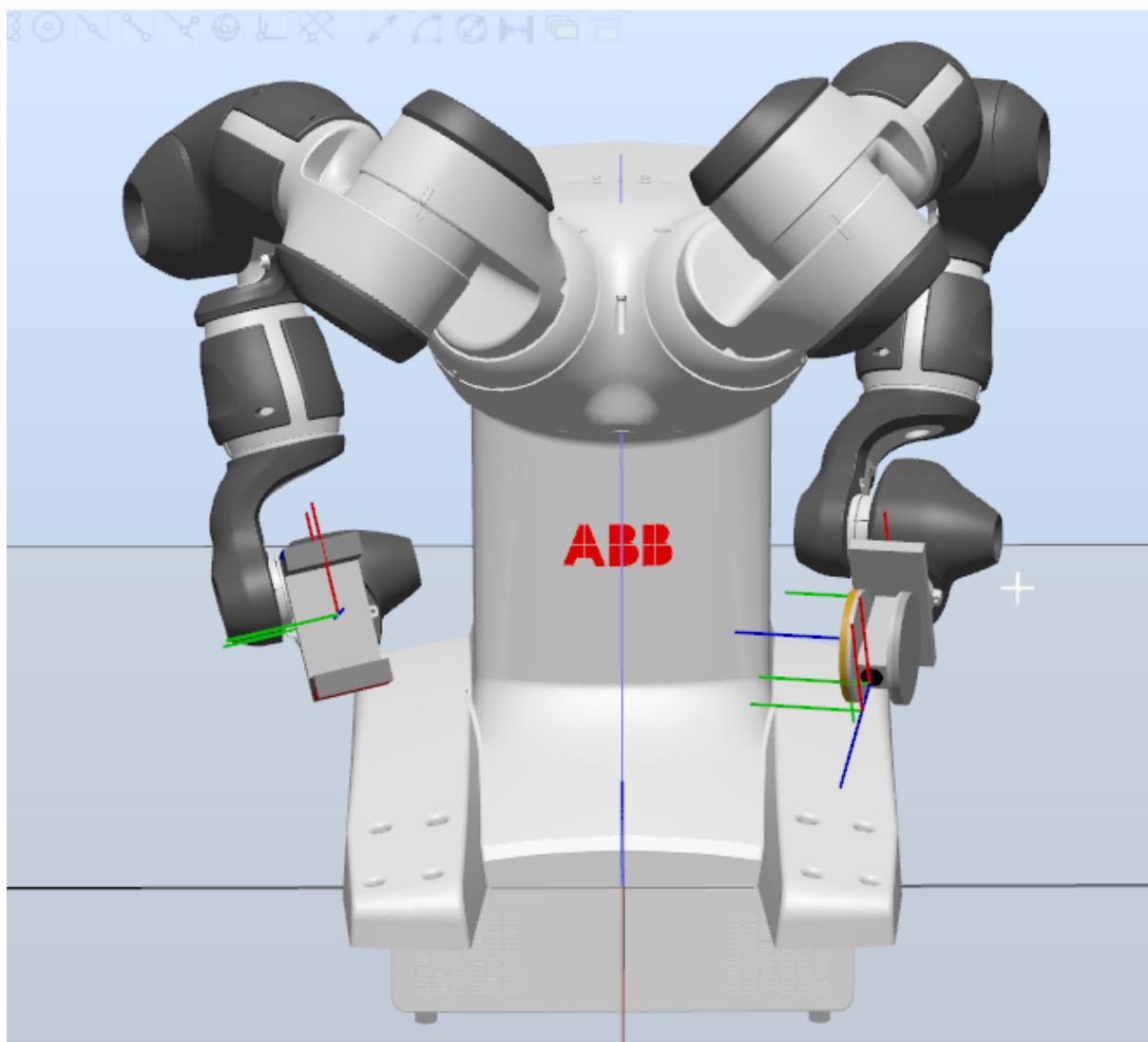
The movement is programmed to vibrate, this is just to remove in a better way the food and dust of the plates.



Finally we have our washer, dryer and camera tool in the robot.



**Full Robot Diagram**

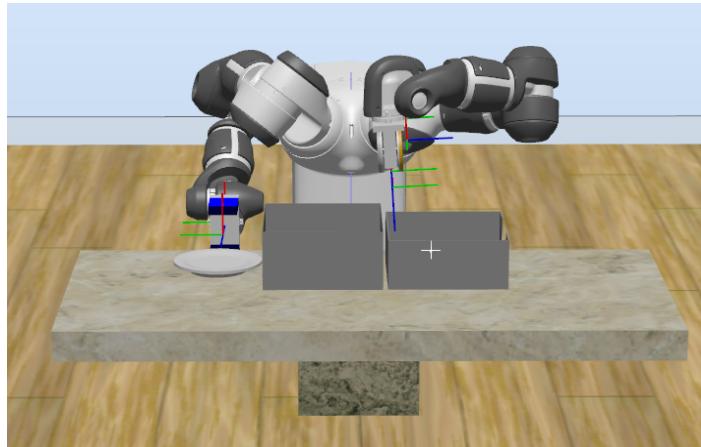


## Work Space

The initial workspace is made by a simple floor, in this case made by wood and a table of

marmol. This table is simulating the table in real life.

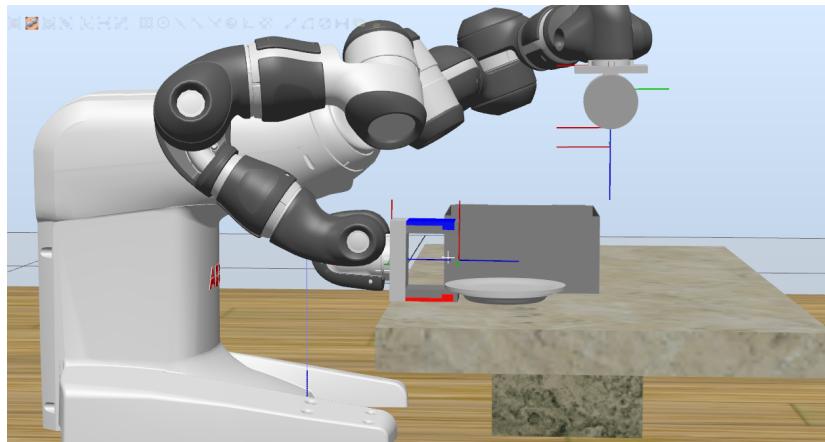
### Initial Position



Now we need to set up the environment. With all the objects that our robot will need to perform the best way its task.

### Take Plate

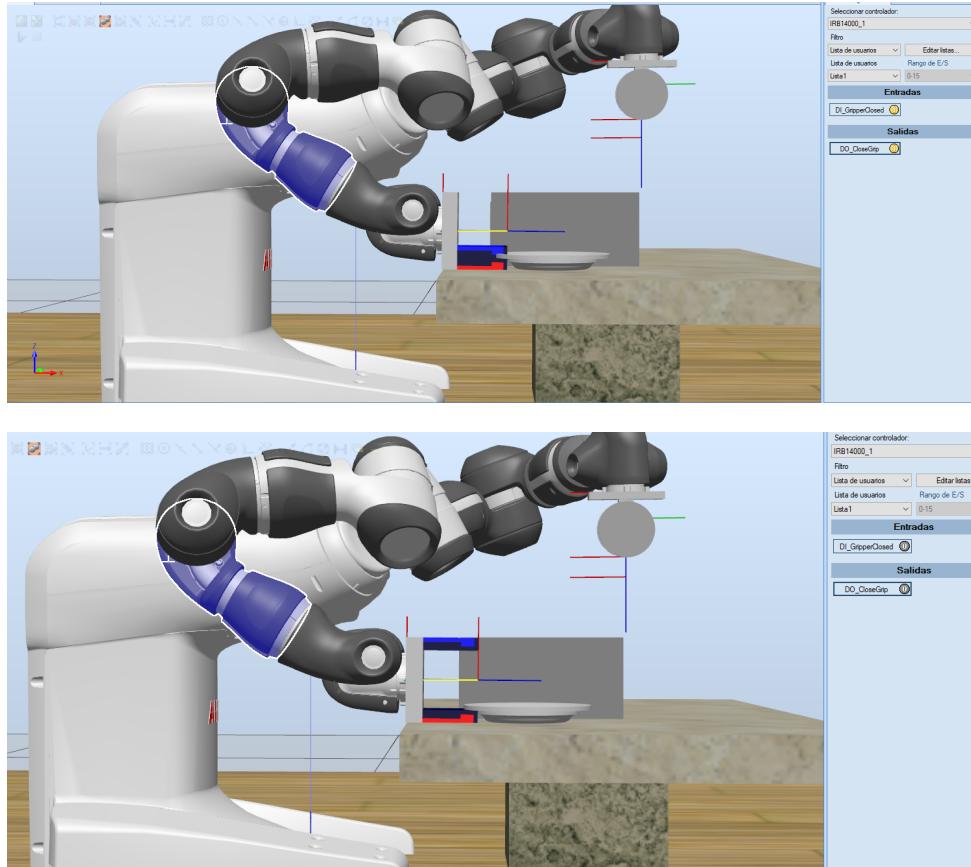
For this we need to approach a suitable position for the robot, and then we create an output signal to close and open the grip.



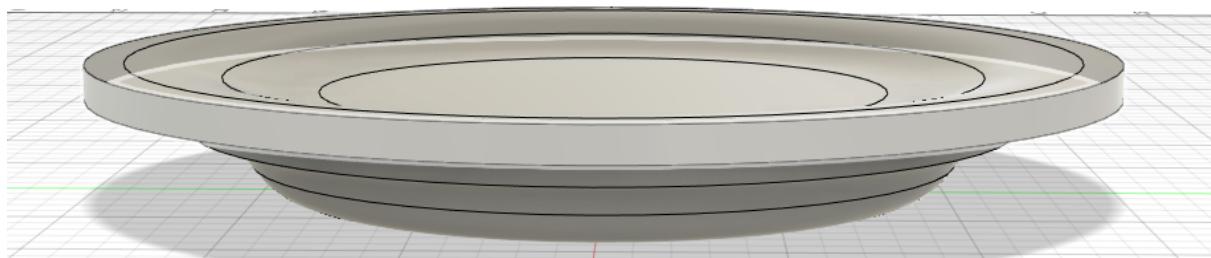
Instancia editor			Instancia editor		
Nombre	Valor	Información	Nombre	Valor	Información
Name	DO_CloseGrip	Cambiado	Name	DI_GripperClosed	Cambiado
Type of Signal	Digital Output	Cambiado	Type of Signal	Digital Input	Cambiado
Assigned to Device			Assigned to Device		
Signal Identification Label			Signal Identification Label		
Category			Category		
Access Level	All	Cambiado	Access Level	All	Cambiado
Default Value	0		Default Value	0	
Invert Physical Value	<input type="radio"/> Yes		Invert Physical Value	<input type="radio"/> Yes	
Safe Level	DefaultSafeLevel		Safe Level		
Activación	Tipo de disp...	Sistema de disp...	Nombre de disparador	Parámetro de disparador	Tipo de acc...
Activado	E/S	IRB14000_1	DO_CloseGrip	1	Mover mec...
Activado	E/S	IRB14000_1	DO_CloseGrip	0	Mover mec...
Activado	Conexión			SS_GripperIsClosed	Cambiar E/S
					IRB14000_1
					DI_GripperClosed
					Parámetro de acción
					Mover mecanismo hast... RightGrip : Cerrado
					Mover mecanismo hast... RightGrip : Abierto

These are the events to open and close the gripper, using I/O signals.

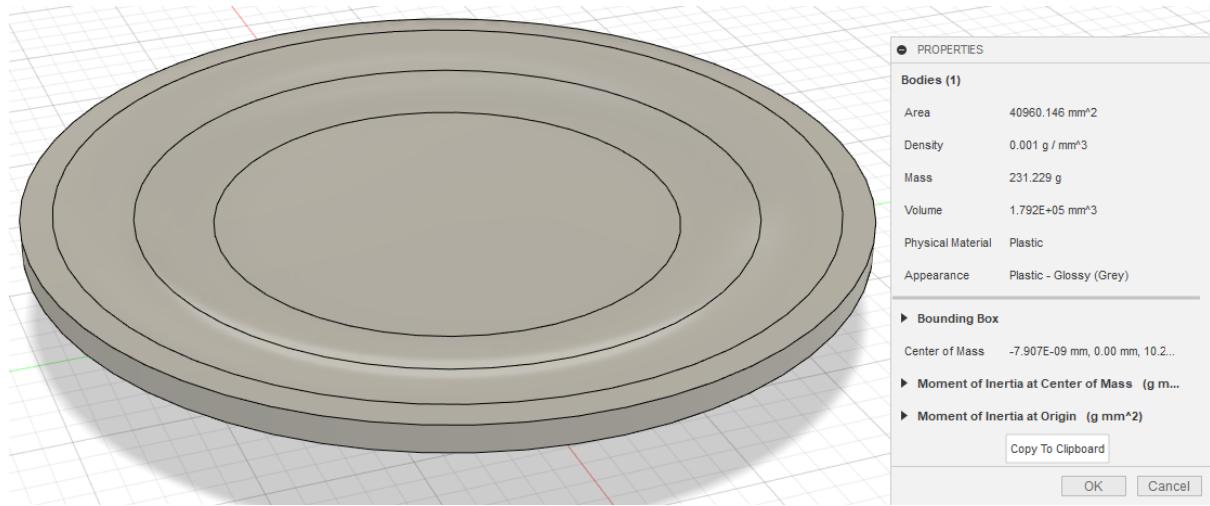
When we close the gripper, the sensor of the gripper turns on, indicating that it is closed, and when the gripper is on, the sensor turns off.



## Plates

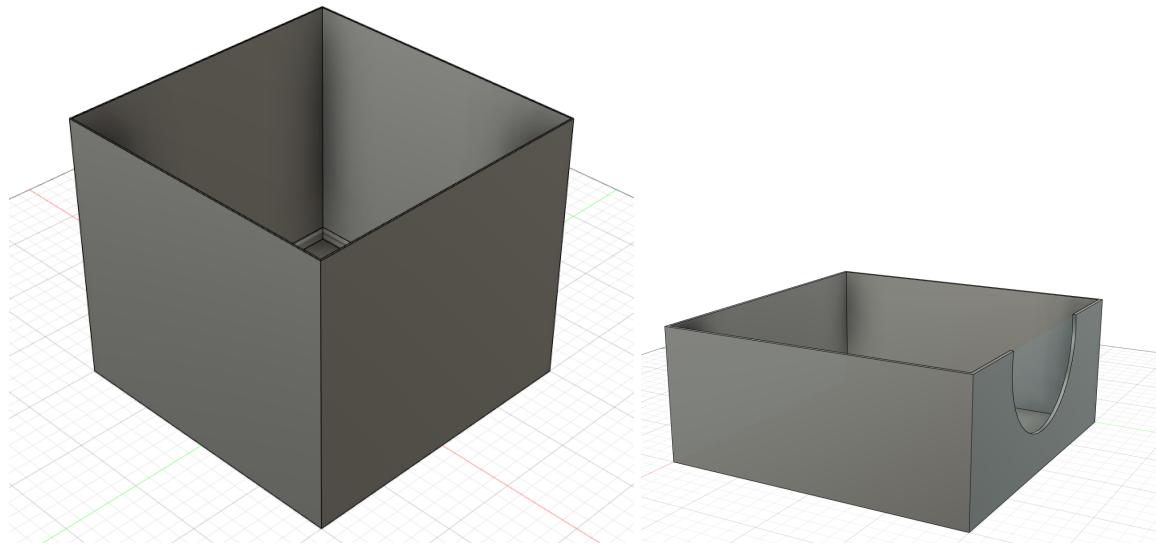


This plate it is made of plastic, and has a radius of 75 mm and a weight of 231.229 g



## Sink

The sink helps us to represent where the water is, and also where the water with soap is.



Clean Water Sink

Water with Soap

## Video Demonstration

**Front view:**

<https://youtu.be/2fhmxy4EdvY>

**Side View:**

[https://youtu.be/SSnkr\\_frexk](https://youtu.be/SSnkr_frexk)

### **Conclusions**

**Héctor Javier Pequeño Chairez** - In the last project we develop and perform the design of the tools of a robot, one of the most important things that I learned was the use of the Fusion 360 CAD, also the Robot Studio, but I realize that I need to practice more the Computer vision subject, because we could not implemented on the project.

**Stephanie Denisse Benitez Cabrera** - In this project I learned to design a robot and its tools, I learned how to create movement and to make it accomplish a task. I also learned how important robotics is and how complex it can get. I believe humans now are so used to have everything delivered on their hands that they don't notice how much it takes to design a robot, to make it work and do it the most optimize way.

### **Papers related to the project:**

Bogue, R. (2017), "Domestic robots: Has their time finally come?", *Industrial Robot*, Vol. 44 No. 2, pp. 129-136. <https://doi.org/10.1108/IR-01-2017-0018>

Smarr, CA., Mitzner, T.L., Beer, J.M. et al. Domestic Robots for Older Adults: Attitudes, Preferences, and Potential. *Int J of Soc Robotics* 6, 229–247 (2014).  
<https://doi.org/10.1007/s12369-013-0220-0>

### **Bibliography:**

Bentley, D. P. (2020, July 27). *Robots: What you need to know about the past, present and future of Robotics*. BBC Science Focus Magazine. Retrieved November 30, 2021, from <https://www.sciencefocus.com/future-technology/robots/>.

Simon, M. (2018, May 17). *Everything you ever wanted to know about robots*. Wired. Retrieved November 30, 2021, from <https://www.wired.com/story/wired-guide-to-robots/>.