**Software Design:** The software for the robotic pick-and-place sorting system was fully written with the Robotic Operating System middleware suite. Firstly, a workspace was created in ROS and a directory called **src** was created which contains all source files. Afterward, the ROS environment which we created was installed and configured. Since the installation of ROS is likely write-protected, it is not wise to modify the base installation without specific reasons. Therefore, we created a new path in the home directory and prepended it to the **ROS PACKAGE PATH**, and created additional packages in there. Prepending a path to **ROS PACKAGE PATH** causes all **rosbash** functions, such as **roscd**, to search through that path before moving on to the later paths, searching the default installation last.

**Model Development:** The model which we considered for our simulation is Universal Robots' UR5 industrial robotic arm. The UR5 robot is a strong, precise, rugged, and robust 6 degree of freedom manipulator. The UR5 can also be integrated with other types of robots usually on a Husky or Ridgeback in combination with a variety of end effectors and Force Torque sensors. The UR5 has a reach radius of 850mm and a payload capacity of up to 5kg.

**Simulation Overview:** Gazebo is a physics-based simulation tool that allows users to create and simulate robotic systems in a 3D environment. It is an open-source platform that is widely used in robotics research and URDF file for the gripper and UR5 arm development and it allows users to design, build, and test robotic systems in a simulated environment before deploying them in the real world. It provides a realistic and dynamic simulation environment with support for a wide range of sensors, actuators, and controllers. The physics engine used in Gazebo simulates the effects of gravity, friction, collisions, and other physical interactions between objects.

RViz is a 3D visualization tool that is commonly used in robotics to visualize and interact with simulated or actual robotic systems. It is a part of the Robot Operating System (ROS) suite of tools and libraries, and it can be used to visualize and debug sensor data, robot models, and 3D environments. RViz allows users to view and interact with 3D models of robots and their environment, as well as visualize sensor data such as point clouds, camera images, and laser scans. It provides a variety of different visualization tools and options, including 2D and 3D views, different coordinate frames, and customizable displays. Both RViz and Gazebo are launched when we run the launch command.

**Simulation Analysis and Results:**

Gazebo and RViz: The simulation can be used to test and refine the robot's behavior by adjusting its control system or modifying the simulation environment. This allows developers to iteratively improve the robot's performance and ensure that it is capable of accurately completing its tasks. Here the UR5 arm is simulated and the environment is built for the pick-and-place action. The robot model was simulated using the custom-made URDF file which was imported.