MTRN4230 Robotics

Assignment 1

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1 SAFETY QA

1.1 Explain the steps in "Pre-Use Assessment"?

The steps of assessments can be explained and summarised as below,

Aims	Content	Explanation
To examine the safety inputs	1. Test that emergency stop buttons and input stop the robot and engage brakes. 2. Test that safeguard input stop the robot motion. If safeguard reset is configured, check that it needs to be activated before motion can be resumed. 3. Examine the initialization screen to test that reduced mode can switch the safety mode to reduced mode. 4. Test that the operational mode switches the operational mode, see icon in top right corner of user interface. 5. Test that the 3-position enabling device must be pressed to enable motion in manual mode and that the robot is under reduced speed control.	The first two assessments are designed to ensure that the operating universal robot can receive and respond the safety inputs of emergency stop button, safeguard stop, or safeguard reset. The third to fifth assessments are to validify if the robot system can run in a specific mode or the modes can be converted.
To examine the safety outputs	6. Test that System Emergency Stop outputs are actually capable of bringing the whole system to a safe state. 7. Test that the system connected to Robot Moving output, Robot Not Stopping output, Reduced Mode output, or Not Reduced Mode output can actually detect the output changes.	These two assessments are to validify if the safe outputs are identified by the robot system, then the robot needs to make corresponding security actions.

1.2 Shortlist integrator role in this document?

The integrator of the universal robot should be aware of the necessary safety information mentioned in technique files before the robot starts to operate. The integrator is the entity that designs the final robot installation and generates the final risk assessment. The integrator should ensure that the robot needs to follow the local regulations and secure user safety. The responsibilities of integrator are including in general,

- Conducting a risk assessment for the whole robot system and additional devices.
- Prepare the methods or functions for facing hazards in the software.
- Noticing safety specifications or documentation for users.
- Encapsulating any safety measures or settings that cannot be adjusted.
- Ensuring the installation of the robot system stably and correctly.

1.3 Summary modes in the robot?

The modes of the universal robot are summarized as follows,

- Normal mode: is the safety mode depending on the default.
- Reduced mode: is a mode that can be triggered when the robot tools or elbows move beyond the safety plane, or the safety inputs are applied. It will limit the positions of the robot moving.
- Recovery mode: is a mode that can restart the safety system when the safety limits are not satisfied by the operating robot arm. It will make the robot return to the safety limits or boundaries of recovery mode which are shown below.

Safety Function	Limit
Joint Speed Limit	30 °/s
Speed Limit	250 mm/s
Force Limit	100 N
Momentum Limit	10 kg m/s
Power Limit	80 W

1.4 Explain Start Up and Operation

The procedures of the start-up are purposed to conduct the safety notices and operations for preventing the potential hazards, including the Robot Control Box and the workplace of the robot. Also, it introduces some basic knowledge about how to manipulate the teach pendent, such as INSTALLATION setting to default, mode transmission, buttons, or tabs.

During the general operation of the robot arm, the students are responsible to save the programs into a hard drive. Before the execution of the program, the users should ensure the safety conditions in software and the robot working envelope. The part of “General Operations” also demonstrates the reasons causing the break-off, and the procedures of restarting the robot arm.

1.5 Explain Hazard/Task “Robot tool causing damage to user or equipment”

The hazard of “Robot tool causing damage to user or equipment” may be caused by the sharp tools or components attached to the robot arm. While the robot arm operating, these tools could

contact and injure the users or equipment around the robot.

In order to prevent this hazard, no sharp tools should be used with the robot for any purpose. If a new tool is required to be attached, the tools must be made with soft material or rounded edges. Then, a user with administrator privileges should update the Tool Center Point settings in the ‘safety installation’. Before starting the robot arm, the user needs to ensure the area around the robot is not congested and the user can freely move.

1.6 Explain Shutting Down

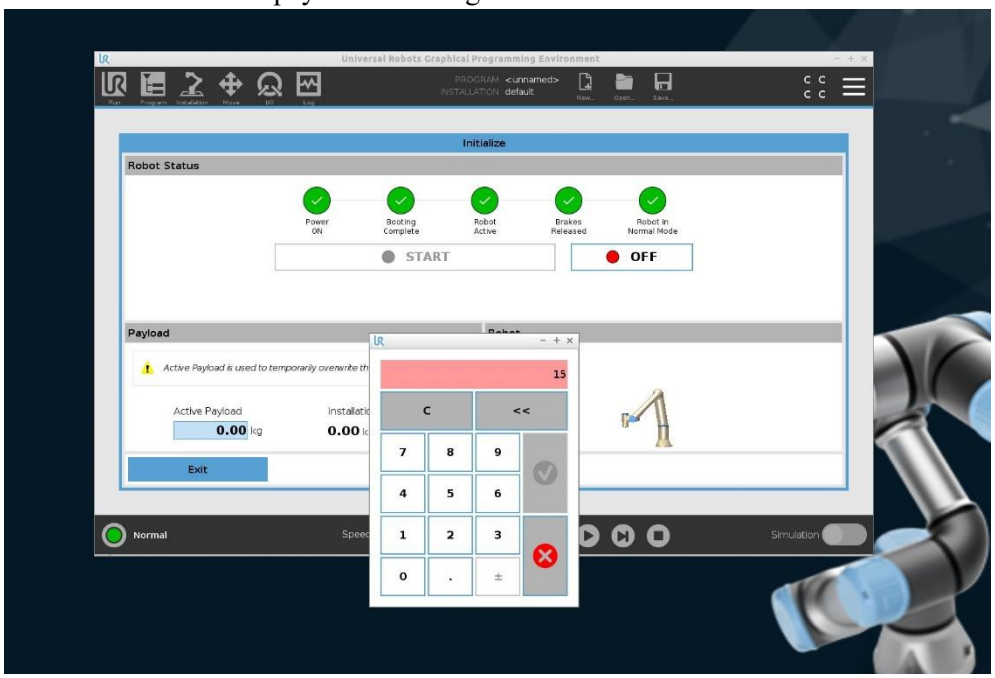
This part is to illustrate the steps need follow to shut down the robot system. After stopping any running programs on the teach pendent, the user should use the Move table for returning the robot arm back to the home position and point the robot tool downward. Then, to disable power to the robot can be done the OFF button appeared on the window popped out by pressing the green circular icon. The users need to store the programs to the flash drive. Pressing the Menu icon, selecting “Shutdown Robot”, clicking “Power Off” to shut down the unit. The teach pendent should be returned to the Robot Control Box, then switch off the power.

2 Online UR5 training

3 Offline UR5 programming

3.1 How much is maximum "Active Payload" for UR5? Set it to 15.

The maximum “active payload” is 7.5kg.

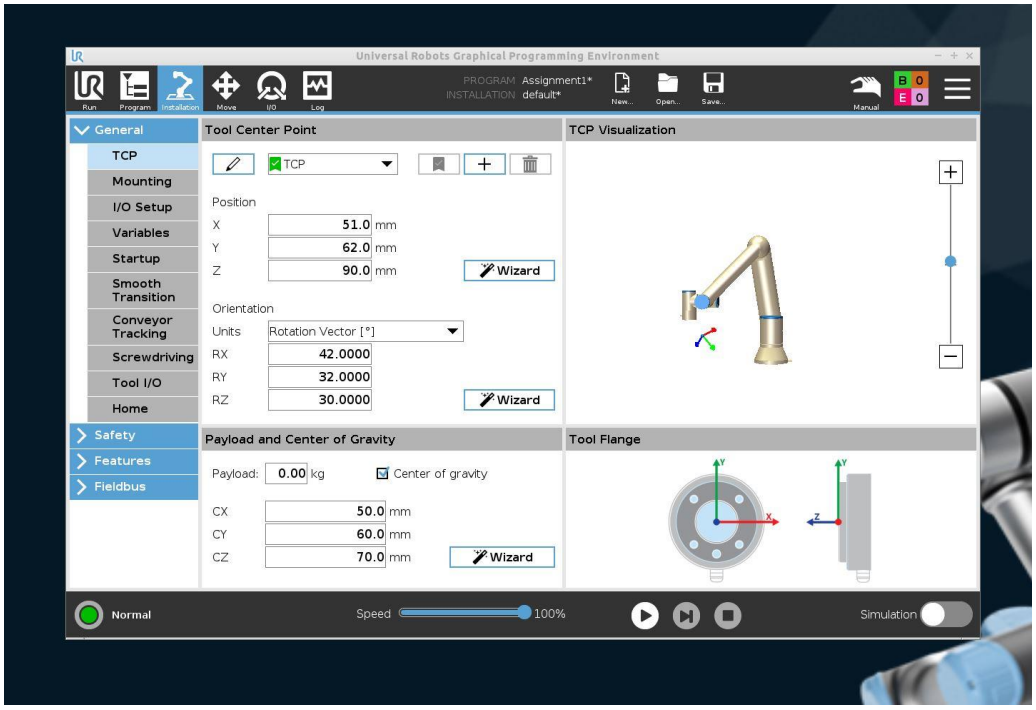


3.2 Set

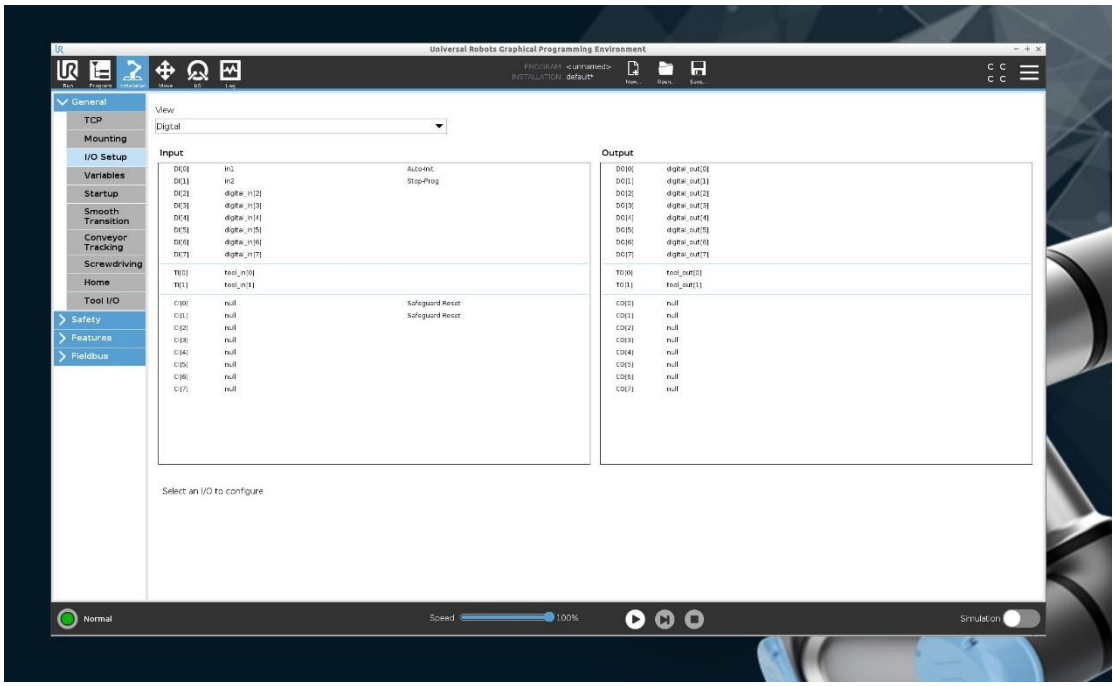
a. the tool Position to X = 5.1cm, Y= 6.2cm, Z = 0.9cm

b. the tool orientation to RX = 42, RY 32, Rz 30

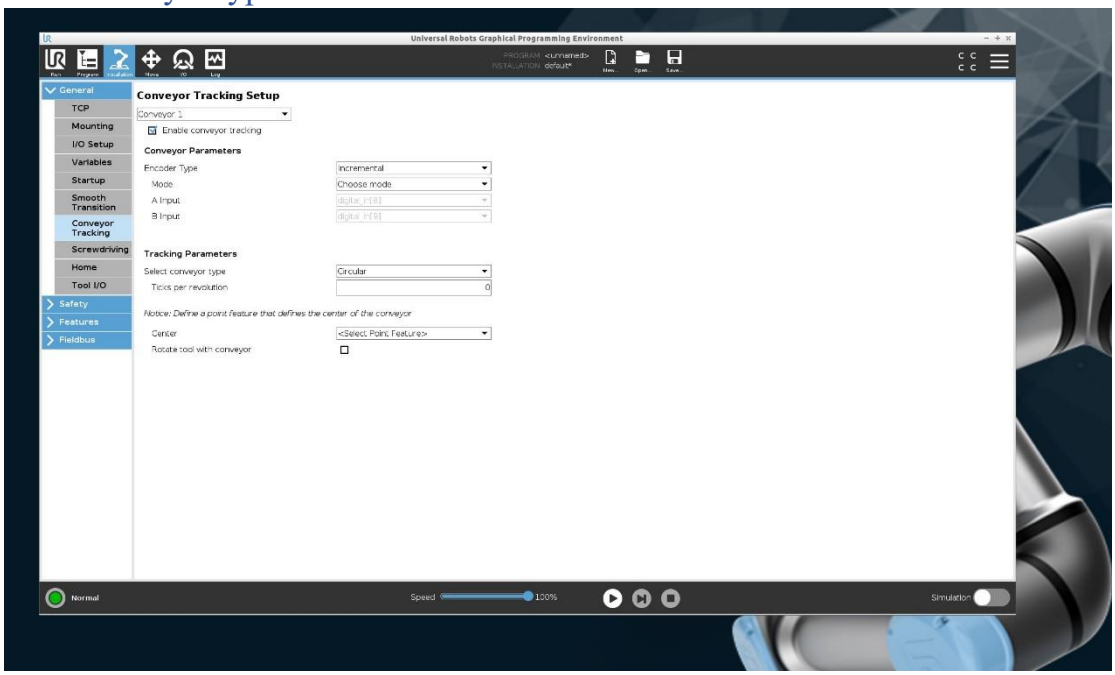
c. Centre of gravity to X = 50mm, Y=60mm, Z = 70mm



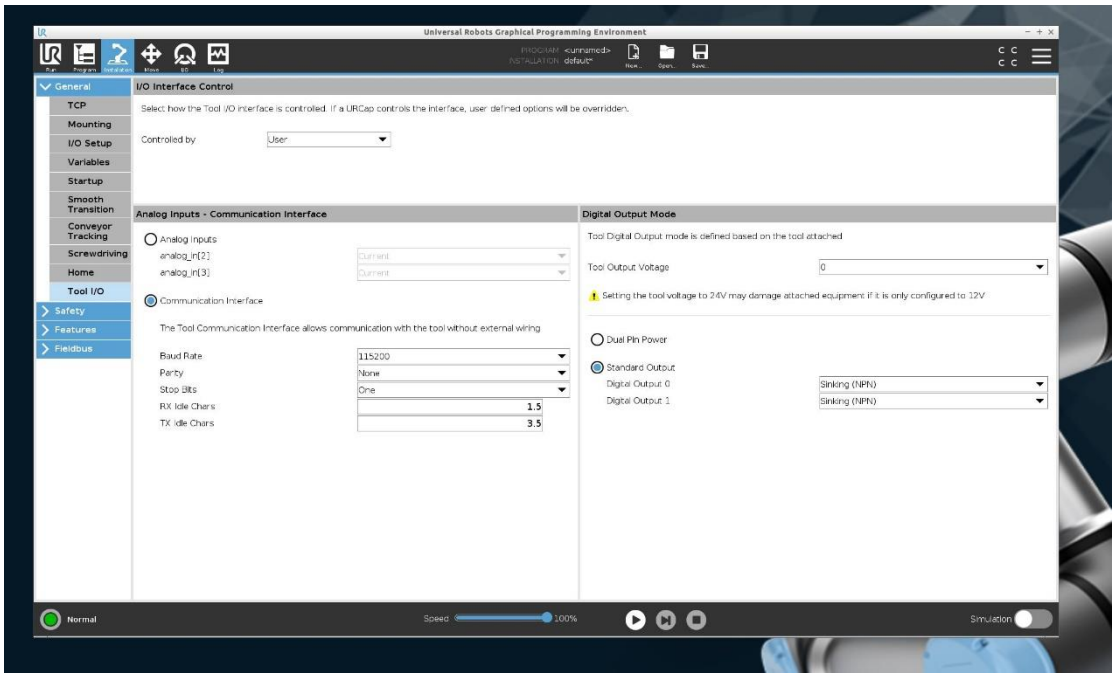
3.3 Add two digital inputs and name them in1 and in2. Connect in1 to Auto-init and in2 to Stop-Prog.



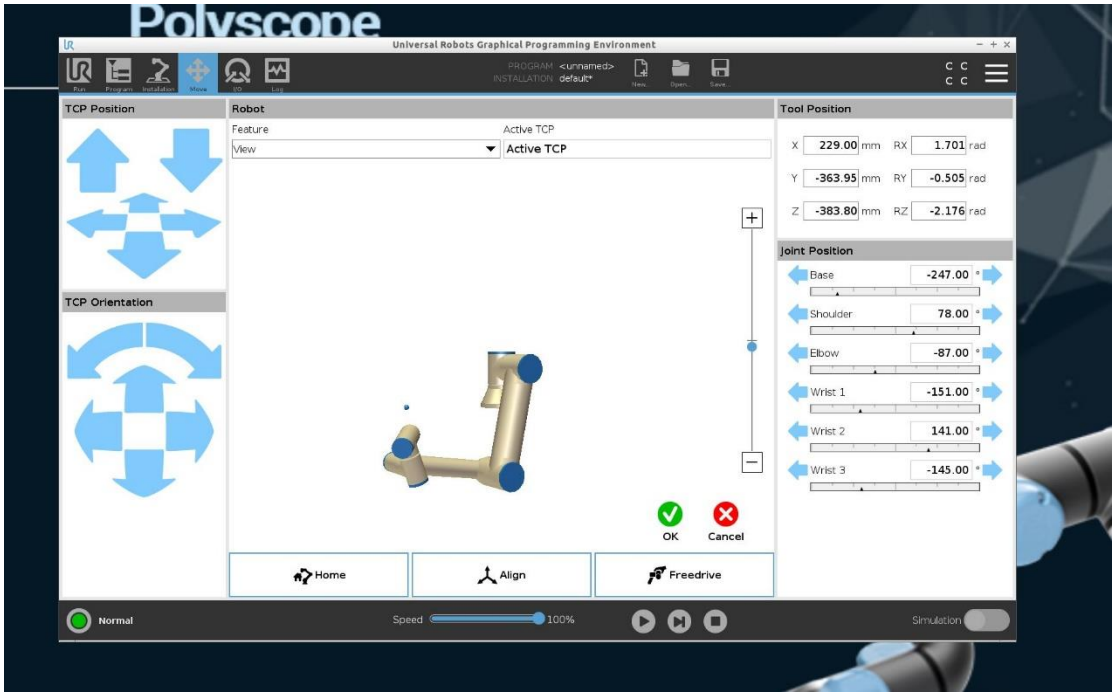
3.4 Conveyor Tracking to be set to Conveyor1, Encoder Type incremental and conveyor type as Circular



3.5 Set the communication baud rate to 115200



3.6 Set the home position to Base -247, Shoulder 78, Elbow -87 and Wrist 1 to -151, Wrist 2 to 141 and Wrist 3 to -145



3.7 Create a safety plane named Plane 1 based on Feature Base with restrictions as Normal and Displacement of 12. Note it's a Restrict Elbow.