



Istanbul Technical University
Control and Automation Engineering
Department

Robotics Laboratory Implementation

Controlling the Universal Robots UR3 Robotic Arm
through ROS

Documented By: Alperen Demirkol

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1. TO BE APPLIED TO THE PC

First of all this is the link you need the most:

https://github.com/UniversalRobots/Universal_Robots_ROS_Driver

Firstly clone the repository to your computer as follows:

```
$ source /opt/ros/noetic/setup.bash
$ mkdir -p ur_ws/src && cd ur_ws
$ git clone https://github.com/UniversalRobots/Universal_Robots_ROS_Driver.git src/Universal_Robots_ROS_Driver
$ git clone -b calibration-devel https://github.com/fmauch/universal_robot.git src/fmauch_universal_robot
$ sudo apt update -qq
$ rosdep update
$ rosdep install --from-paths src --ignore-src -y
$ catkin build
$ source devel/setup.bash
```

There will be two folders in the src folder. One contains the driver to communicate with the robot and the other contains the moveit config packages to control it.

Second thing to do is to create new network id from ubuntu settings. For this, the following instruction can be followed: Go to Ubuntu settings Go to the Network tab Click the add button from the Wired section In the IPv4 part, the method is Manual, the address is 192.168.1.11 (the IP may be different, it should be set from the panel, this topic will be mentioned), Netmask is set to 255.255.255.0 . A nice name can be given from the Identity tab (I have UR3). When the systems are ready and the Ethernet cable is connected after registering this network, it is necessary to make sure that this is the network ID selected in the wired tab.

Extra improvements can be made, for example, in the normal version, the RViz screen did not open directly with the launch file, and Moveit!, such as placing an obstacle to prevent the arm from hitting.

2. TO BE APPLIED TO THE ROBOTIC ARM

To control the robot arm panel externally (ROS in our case), a .urcap file must be attached, allowing the system to allow this and opening additional settings. The externalcontrol file in the resources location of the workspace that we installed on the PC should be downloaded to the panel via a flash memory and installed.

https://github.com/UniversalRobots/Universal_Robots_ROS_Driver/blob/master/ur_robot_driver/doc/install_urcap_cb3.md

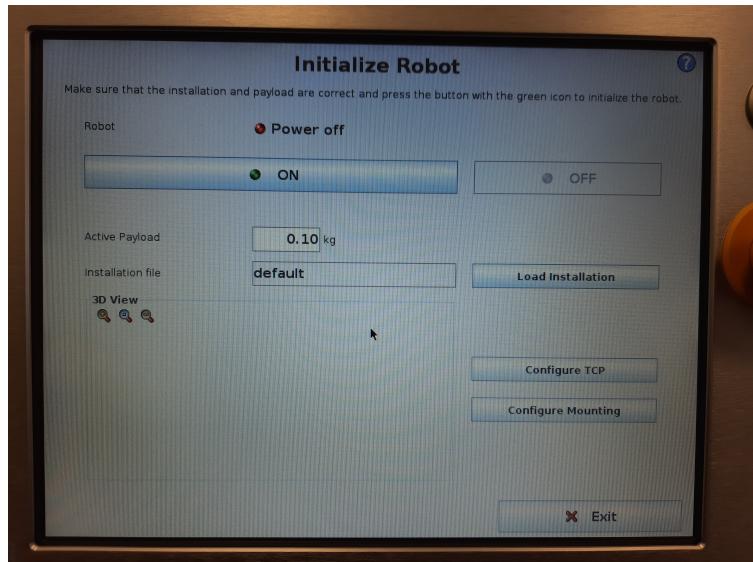
As explained in the link above, after the reboot, from the main menu, go to the program robot->Installation->External Control tab. In the host ip part, we must write the same IP address that we wrote in the network id created on the PC (in my case 192.168.1.11). Next, we need to create a program and insert the external control into the program. We enter the empty program from the program tab. Here we press the External Control button under the URCaps tab of the Structure tab. Then we save this program and exit.

Do not enable Ethernet/IP and Profinet settings. Because these features occupy the ports, the driver cannot connect with the robot arm.

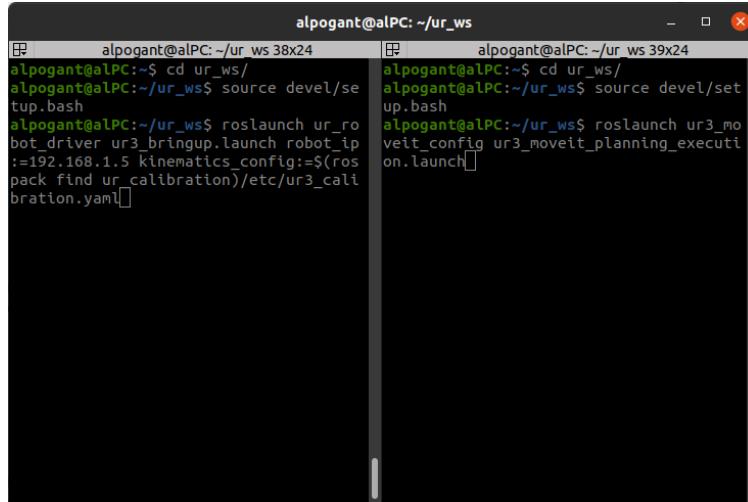
3. RUNNING THE PREPARED SYSTEM



(a) Make connection between robot and PC



(a) Power on and go initializing page



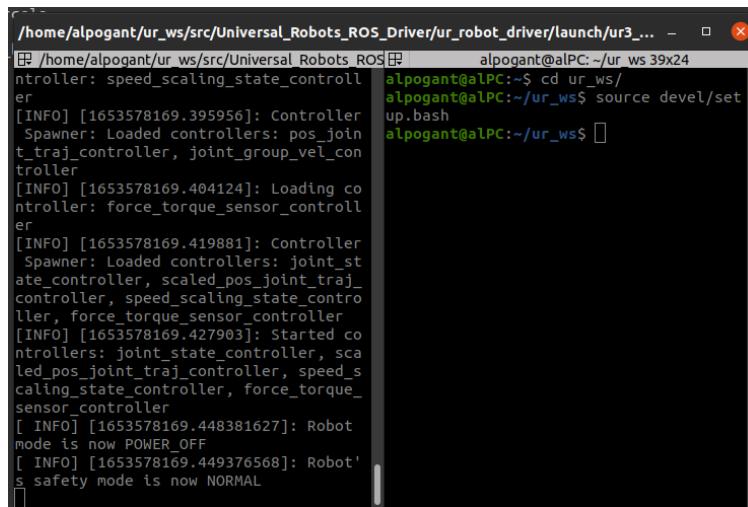
The image shows two terminal windows side-by-side. The left terminal window has a title bar 'alpogant@alPC: ~/ur_ws 38x24'. It contains the following command and its output:

```
alpogant@alPC:~$ cd ur_ws/
alpogant@alPC:~/ur_ws$ source devel/setup.bash
alpogant@alPC:~/ur_ws$ roslaunch ur_robot_driver ur3_bringup.launch robot_ip:=192.168.1.5 kinematics_config:=$(ros pack find ur_calibration)/etc/ur3_calibration.yaml
```

The right terminal window has a title bar 'alpogant@alPC: ~/ur_ws 39x24'. It contains the following command and its output:

```
alpogant@alPC:~$ cd ur_ws/
alpogant@alPC:~/ur_ws$ source devel/setup.bash
alpogant@alPC:~/ur_ws$ roslaunch ur3_moveit ur3_moveit_planning_execution.launch
```

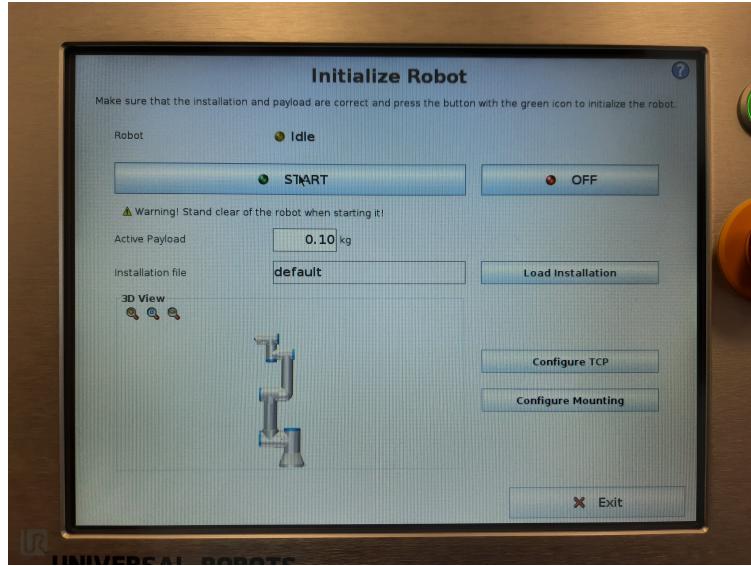
(a) On PC side run driver package and moveit in different terminals



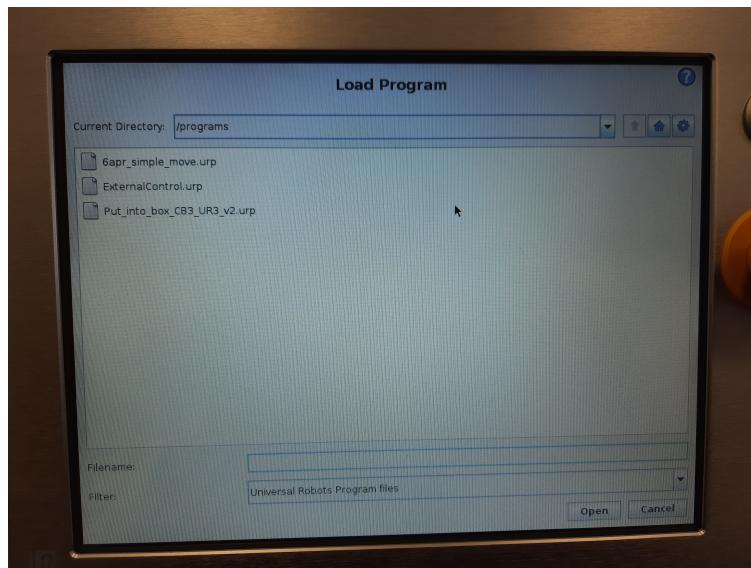
The image shows a single terminal window with a title bar 'alpogant@alPC: ~/ur_ws 39x24'. It displays the logs from the ROS driver startup. The logs show the loading of various controllers and the transition of the robot node to POWER_OFF and NORMAL safety modes.

```
/home/alpogant/ur_ws/src/Universal_Robots_ROS_Driver/ur_robot_driver/launch/ur3_...
/home/alpogant/ur_ws/src/Universal_Robots_ROS_Driver/ur_robot_driver/launch/ur3_...
[INFO] [1653578169.395956]: Controller Spawner: Loaded controllers: pos_joi...
[INFO] [1653578169.404124]: Loading controller: force_torque_sensor_controller
[INFO] [1653578169.419881]: Controller Spawner: Loaded controllers: joint_st...
[INFO] [1653578169.427903]: Started controllers: joint_state_controller, sca...
[INFO] [1653578169.448381627]: Robot node is now POWER_OFF
[INFO] [1653578169.449376568]: Robot's safety mode is now NORMAL
```

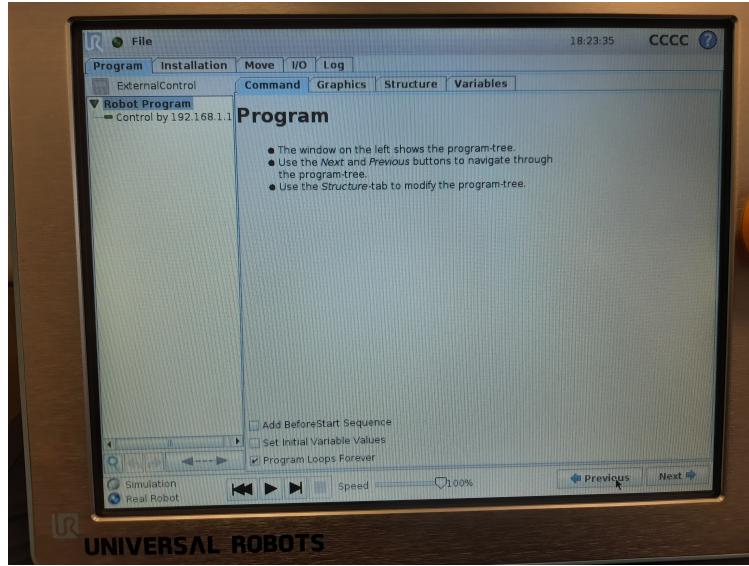
(a) After run the driver we should see INFOs in terminal



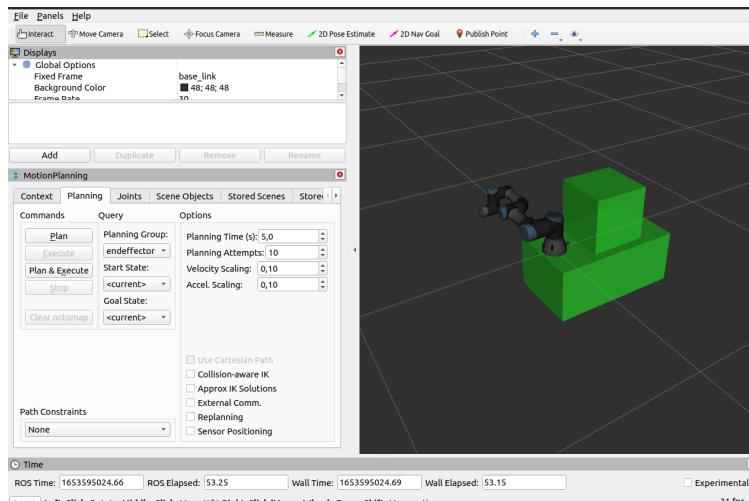
(a) Push start button on panel and see changes on terminal



(a) Main menu->Program robot->Load Program then select External Control



(a) You will see this page, press the play button at the bottom of the page



(a) Run second terminal, it will open a Rviz motion planning

4. REFERENCES

https://github.com/UniversalRobots/Universal_Robots_ROS_Driver

https://github.com/fmauch/universal_robot