Overview of the environment

After accessing the Robotics Digital Twin with the remote desktop, you will see a layout similar to the following figure (Figure 1).

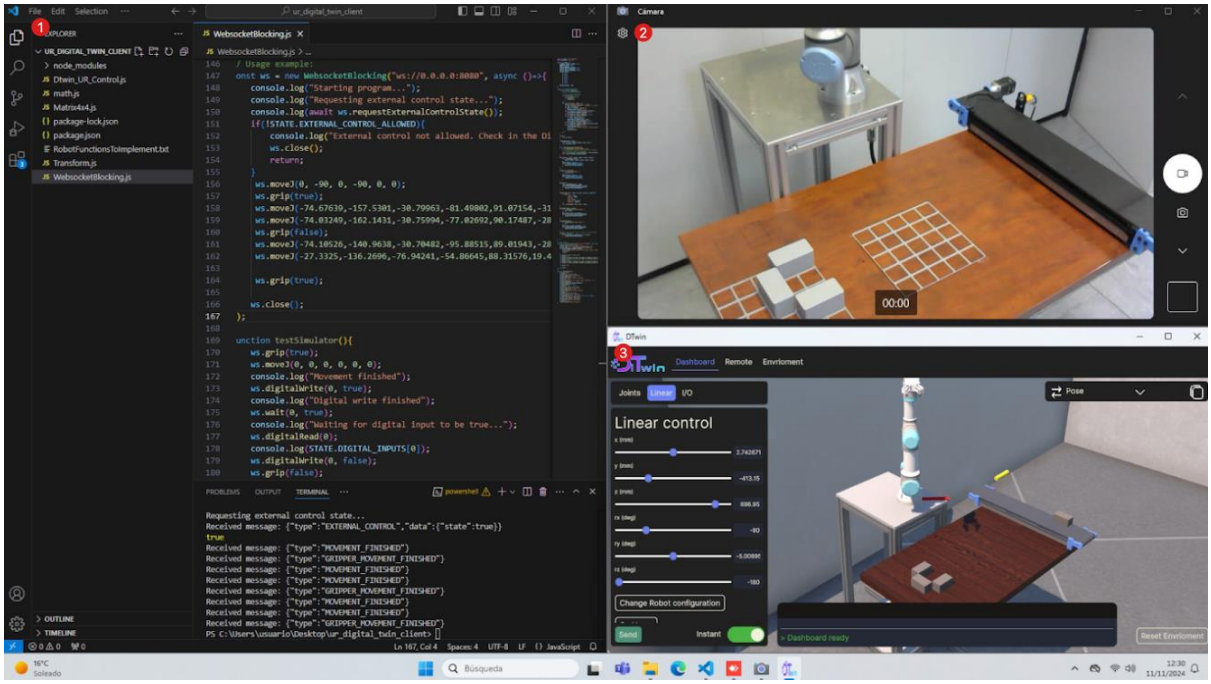

Figure 1. Overview of the environment.

Here you can see the 3 main parts of the Digital Twin.

- The first one is the code editor, in this case Visual Studio Code. Here, you will write and execute the code.
- The second one is a live feed of a webcam. Here you can see the real robot in the lab.
- The third one is the Digital Twin program. This is the bridge between the code and the real robot, and is what you will interact with the most.
-

Now we will proceed to explain each part in more detail, taking special consideration with the Digital Twin program.

The Code Editor

This is a regular code editor environment that you may be used to. In the exercises and classes, you will learn how to use commands to control the robot. These commands can also be found in the documentation. For everything else, is a Javascript program that we will run using the Node.js runtime.

To write some custom code, do it in the main function that is on the index.js file. We recommend that for the purposes of the exercises, you write all the code on this file, separating some behaviour in functions if needed, as shown in figure 2.

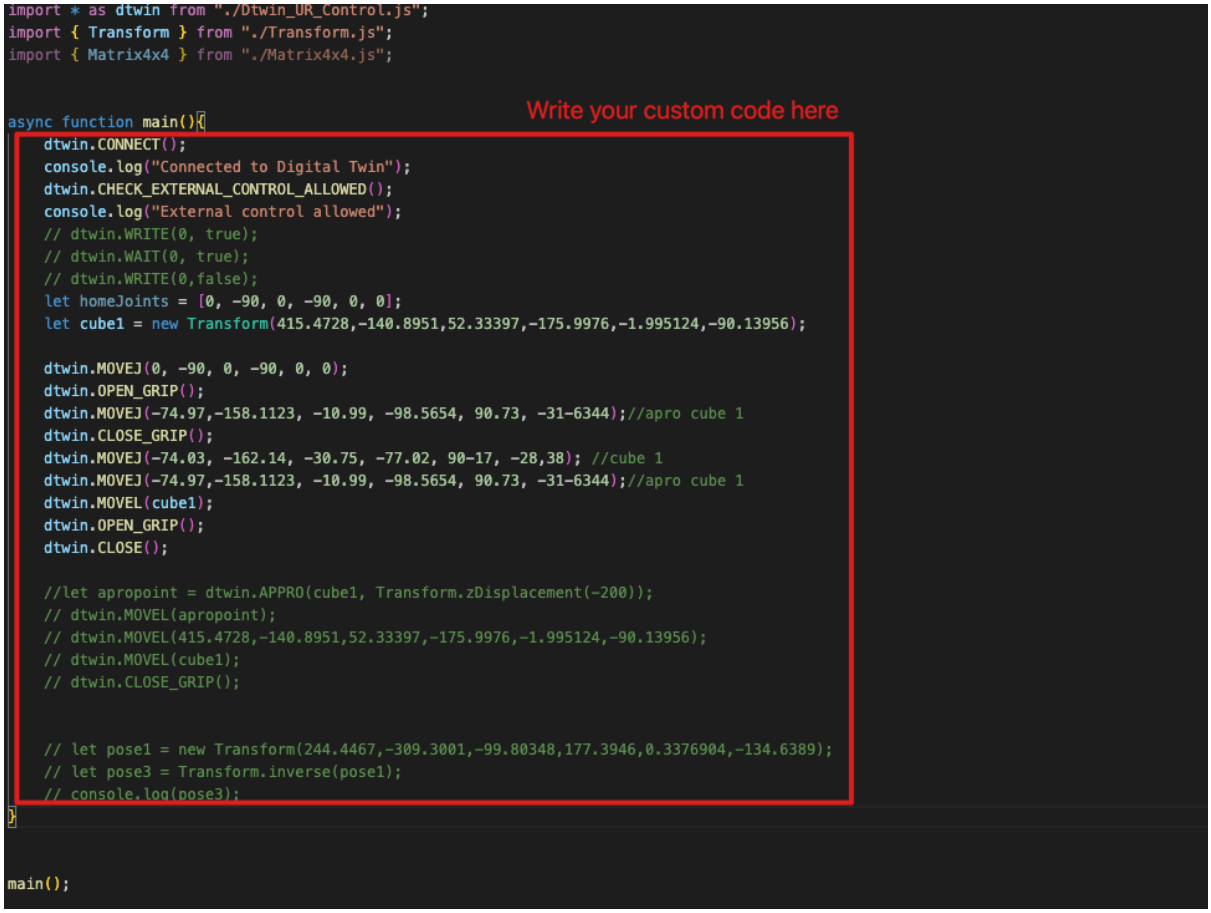

Figure 2. Custom code example.

To run the program that you wrote, use the following command on the console inside visual studio code:

```
node index.js
```

The program may not work if the Digital Twin is not in the correct state. The program should show a warning if so. To understand how to set up the digital twin to be used with custom code, refer to the “Remote Tab” character in this documentation.
Each function that interacts with the Digital Twin is imported on the “dtwin” object. To understand this object and all its functions, refer to the technical documentation.

The Digital Twin

Now we will detail the functionality of the Digital Twin program. This section will divide the functionality using the user interface tabs.

The Dashboard Tab

The dashboard tab is intended to be used as a “playground” to both familiarize yourself with the movement of the robot and to check the positions to be captured. Is not intended to

move the real robot, akin to the simulation mode on many commercial robot arms. You can rotate the camera holding right click, as well as zoom using the scroll wheel.

Figure 3. The Dashboard Tab with the different sections numbered.

Firstly, the left panel, marked as 1 on Figure 3, is the main control of this tab. Is separated on three other tabs, each offering a different way to interact with the Digital Twin.

Figure 4. The Joint Control Tab inside the Dashboard

On the Joint Control Tab, seen in Figure 4, you can move the current joint positions of the robot. You can easily see that you can move the robot to impossible positions (for example, by going through the table). This is by design, so you can visually see when you are trying to get to an impossible position. You can both drag and write the angular position, on degrees, for each link of the robot.

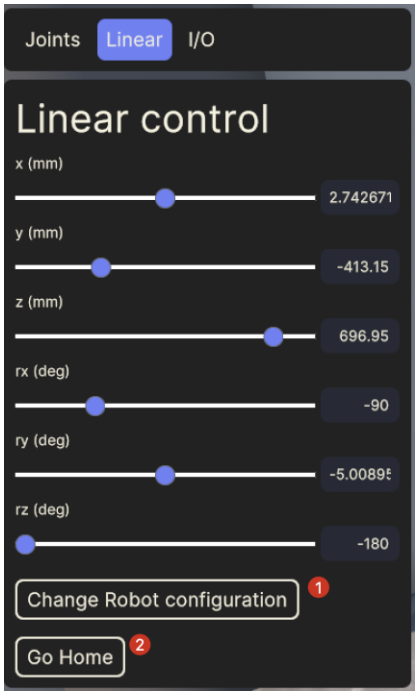

Figure 5. Linear control tab inside the Dashboard

On Figure 5 you can see the Linear control tab. Here you can move the current TCP position of the robot. The Euler angles are on degrees, and each cartesian direction is on millimeters. There are also two buttons, marked with 1 and 2 on the Figure 5. The button number 2, with the label “Go Home”, will move the robot to the home position. The button marked as 1, will open the robot configuration menu, as seen in figure 6. On this menu, you can change the current configuration of the robot. This configuration can also be changed in code (see technical documentation).

Figure 6. Robot configuration Menu.

On the I/O tab, seen in Figure 7, you can control the Digital Outputs of the robot and the Tool, as well as seeing the state of the digital Inputs. The Digital Output 0 is the conveyor

belt START signal, the Digital Output 1 is the conveyor belt DIRECTION signal, and the Digital Input 0 is the proximity sensor.

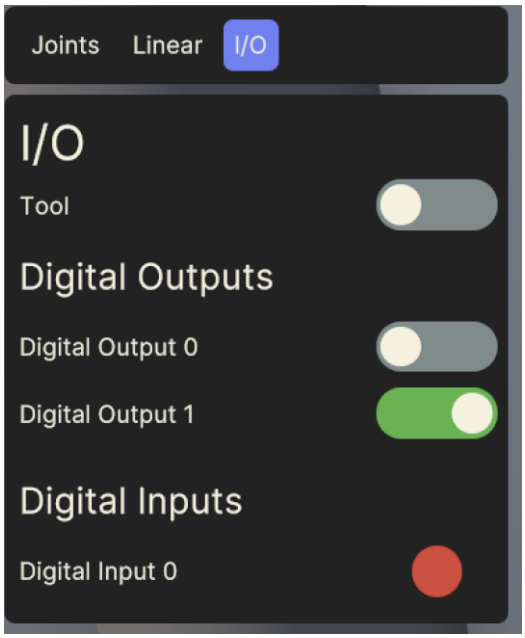

Figure 7. I/O Tab inside the Dashboard.

Taking a look back to the whole dashboard screen, and marked as 2 in Figure 3, is the current position indicator. This is an easy way to see the current position of the robot. You can press the arrow button, marked as 1 on Figure 8, to change the way you see the current position. If you press the copy button, marked as 2 on Figure 8, you will copy this current position on the format accepted by the code.

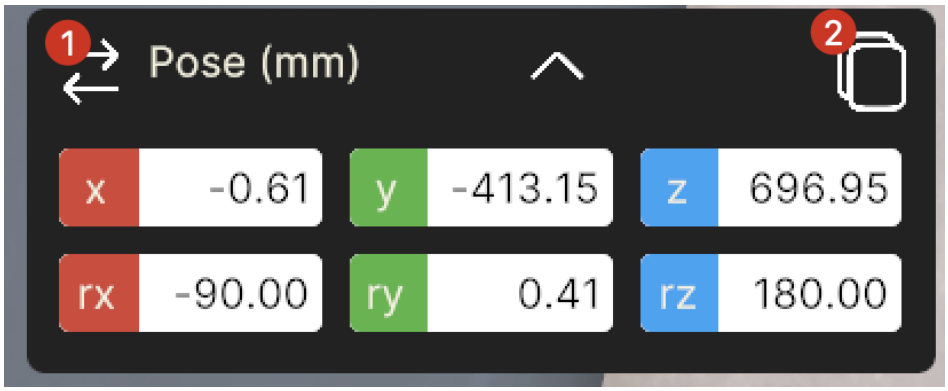

Figure 8. Current Position Indicator inside the Dashboard.

Marked as 3 on Figure 3, is the console output. This will show some relevant information about the digital Twin, like an unreachable pose, as seen in Figure 9.

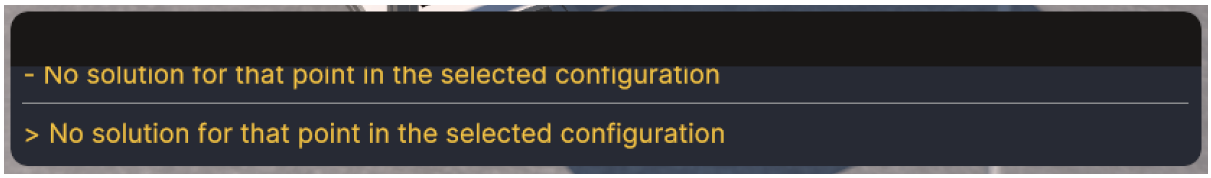

Figure 9. Console output of Dashboard Tab showing an unreachable position.

Marked as 4 on Figure 3 is the Send Button zone. This zone contains also the instant toggle button. This button changes the behaviour of the previous control tabs, and is used to see

the movement of the robot, instead of making it act instantly when you move the sliders. When it is toggled off, you can freely move all the sliders, and then tab the “Send” button. this will move the robot to the desired pose.

And finally, marked as 5 on Figure 3, is the reset environment button. This way you can reset the cubes to the original position, and is useful when you are trying things out on simulation before sending the program to the real robot. Is used to synchronize the real state of the lab with the digital twin.

The Remote Tab

The remote tab, and overview of which you can see on Figure 10, is used to interact with the Digital Twin through code.

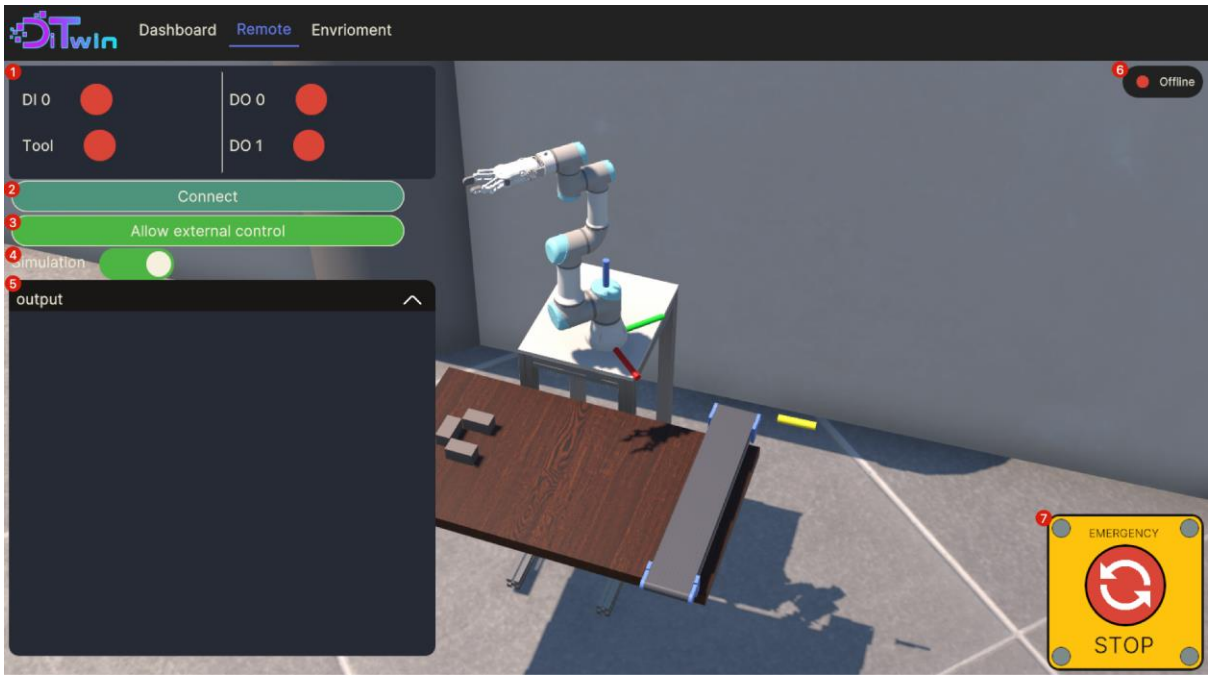

Figure 10. The Remote Tab.

Marked as 1 on figure 10, is the I/O visualizer. Here, you can see the current state of all the input and outputs of the system.

Marked as 2, is the connect button. This is used to connect to the real robot.
Marked as 3, is the Allow External Control button. This is a safety measure, and if this button is not pressed, no external program will be able to run (nor in simulation mode or to the real robot).
Marked as 4, is the Simulation Mode toggle. This toggle indicates whether the code sended to the Digital Twin will be executed in simulation mode (meaning without the real robot, only digitally) or it will be sent to the real robot. Even if the simulation toggle is off, indicating that the program should be sent to the real robot, you still need to connect to the robot using the previous button.

Marked as 5, is the output console, akin to the one on the Dashboard screen, it will show some information.
Marked as 6, you can see the current state of the connection to the real robot.
Marked as 7, is an emergency stop button. It works both on simulation mode and on the real robot, and is intended to be use, as the name suggest, to stop the movement in case of any emergency.

The Environment Tab

The environment tab, seen on Figure 11, is a simple menu where you can select the current state of the environment, separated by exercises. This will correspond to the exercises shown on the lessons. There are also some graphical settings, to show and hide the Gizmos of the TCP and Robot base.

Figure 11. The environment tab.