Department of Mechanical Engineering
Control Systems Technology Group

Lock configurator RWS manual

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Contents

1 Introduction

To create and operate a digital twin (DT) in Unity, several tools are essential. These tools enable the development and control of virtual replicas of real-world objects or systems.

Tools Required

The following tools are necessary for the creation and operation of digital twins:

- Visual Studio 2022: A software development environment for coding and programming.
- Unity 3D (version 2021.3.6f1): A powerful platform used for creating interactive and immersive experiences.
- Prespective (version 2023.1.1142.3): A software tool used to apply logic and control components in the digital twin environment.
- TwinCAT: A programming environment used to supply PLC code commands to the digital twin.

Configuration Tool

In order to streamline the process of configuring DTs in Unity, an external tool has been created. This tool allows for the importation of configurations into Unity, reducing the need for manual input and enhancing efficiency in the DT development workflow.

Logic Application

Unity, in conjunction with Perspective software, facilitates the application of logic to digital twins. Perspective software provides a visualization and control toolset that enables components to move and allows for the activation and deactivation of lamps within the digital twin environment. This functionality adds interactivity and realism to the virtual replicas.

PLC Code Integration

To supply the digital twins with the necessary commands and instructions, TwinCAT is used. In TwinCAT the corresponding controller to the designed configuration of DT can be loaded and tested.

Prespective License Key

To unlock the complete potential of the Perspective software, a valid license key is required. The license key can be obtained by contacting the Perspective team directly via the form provided on their website: `https://prespective-software.com/download-archive/releases`.

2 External Tool

The external tool can be used to create configuration files, of the type JSON, of different lock configurations; which will be used inside Unity to create the digital twin.
The external tool is started by opening the ISSDT.exe application. The tool can be seen in Figure 2.1.

Figure 2.1: External Tool

Once the tool is opened, it is possible to directly create a configuration, open an existing project or to create a new empty project. To open an already existing project go to `File > Open` or use the key binding `Ctrl + O`. To create a new empty project go to `File > New` or use the key binding `Ctrl + N`. Saving a project is possible by going to `File > Save` or using the key binding `Ctrl + S`.

Steps to create a configuration file:

1. Select a desired component in the `component library` (2).
2. Click somewhere on the canvas (1).
3. The following window will appear:

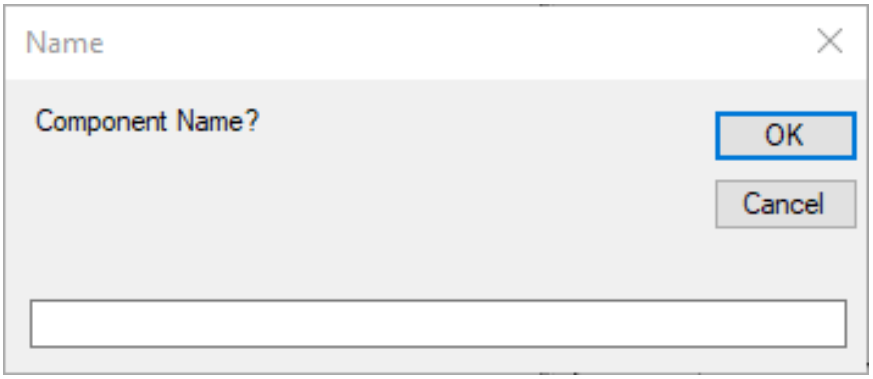

Figure 2.2: Component name window

4. Insert a name for the component; this will become the variable name for the component in the digital twin that is used for the connection between the component and the controller on the physical PLC or TwinCAT. Once done press `Enter` or click "OK".
5. It is now possible to drag and resize the component around the canvas. If a component gets deselected, it can be re-selected by left-clicking on the component on the canvas.
6. Right-clicking on the component gives the following options:
   - Rename
   - Delete
   - Rotate clockwise
   - Rotate counter-clockwise
   - Raise to top
   - Send to bottom

   Rename and delete do what you expect them to do. The rotate options can be used to re-orientate the components, think of the direction of doors or traffic lights. The raise to top and send to bottom options can be used to make the canvas more clear to the user.
7. Repeat steps 1 to 6 to create the desired configuration on the canvas.
8. Selecting a component on the canvas shows basic information about the component on the right of the canvas. This information includes the specified component name and the component type.
9. Click the `Refresh` button at ③.
10. This will update the component hierarchy. In this table it is possible to assign each component to a specific waterway. This can be useful for clustering components that belong to the same waterway. Each entry in the table shows its name and type, to change the waterway a component belongs use the dropdown in the waterway cell. **NOTE: After changing a waterway index be sure to select a different row in the table to confirm the change! This can be checked by making sure that the pencil icon is gone in the first column.**

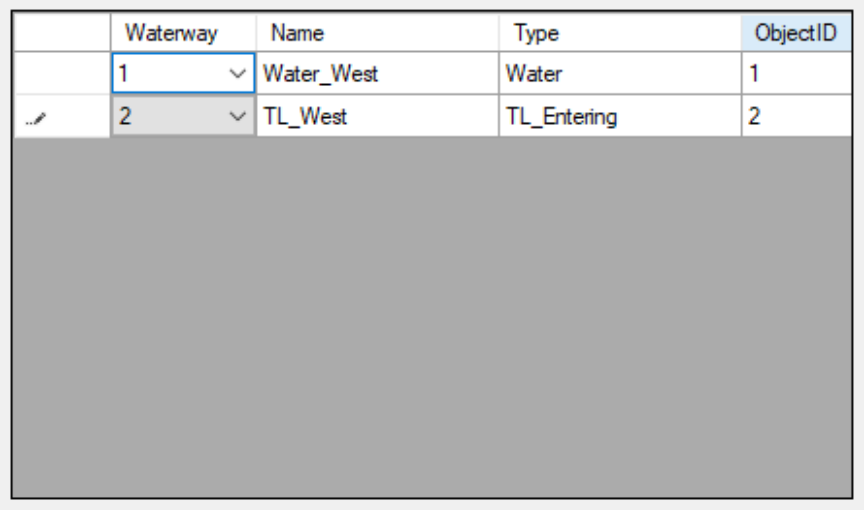

Figure 2.3: Component hierarchy

11. It is possible to save an SVG image of this configuration by going to `File > Generate > SVG Image` or using the key binding `Ctrl + Shift + V`.

12. To create the configuration file we need go to `File > Generate > JSON` or use the key binding `Ctrl + Shift + J`.

13. Enter a name for the configuration to make it easier to remember,

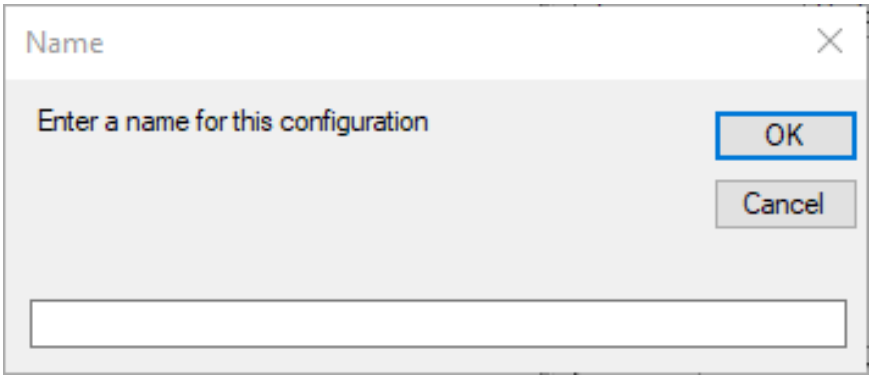

Figure 2.4: Configuration name

14. Select the correct cluster number, this is predefined as 5 as the tool only supports this cluster at the moment.

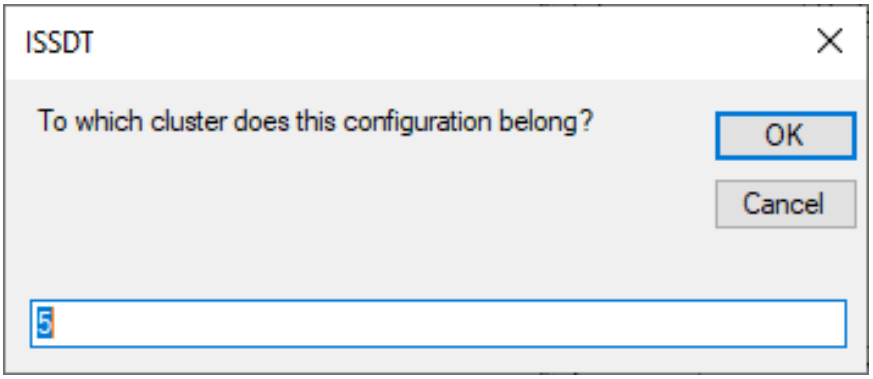

Figure 2.5: Cluster number

15. Store the file in a easy to remember location.

3 Configurator

1. Open Unity and navigate to the *"Configurator"* scene.
2. In the **Hierarchy** panel, select the *"Configurator"* **GameObject**.
3. In the **Inspector** panel, locate the *"Configurator V7"* script responsible for creating the DTs based on the configured settings from the external tool.
4. In the *"File"* field, provide the created JSON file, generated using the external tool as explained in section 2.
5. Add the variables and inputs required for the system. These files should contain the sensor and actuator variables corresponding to the system. Ensure that the variable names in these files match the names assigned to the respective objects in the external tool.
6. Click the *"Load"* button to import the contents of the JSON file into the Unity editor.
7. The parameters can be inspected by expanding the dropdown tab next to the configuration. Modify the values as desired by selecting the relevant box and entering the new values. Note that some elements require integers, while others require floats.
8. The loaded configuration in Unity can be cleared by pressing the "Clear" button.
9. Once satisfied, click *"Create"* to generate the designed configuration in Unity. The configuration can be viewed in both the **Hierarchy** panel and the **Scene view** as seen in Figure 3.2.

In Figure 3.1 the Unity environment can be seen where all locations are indicated corresponding to the step-by-step plan mentioned above.

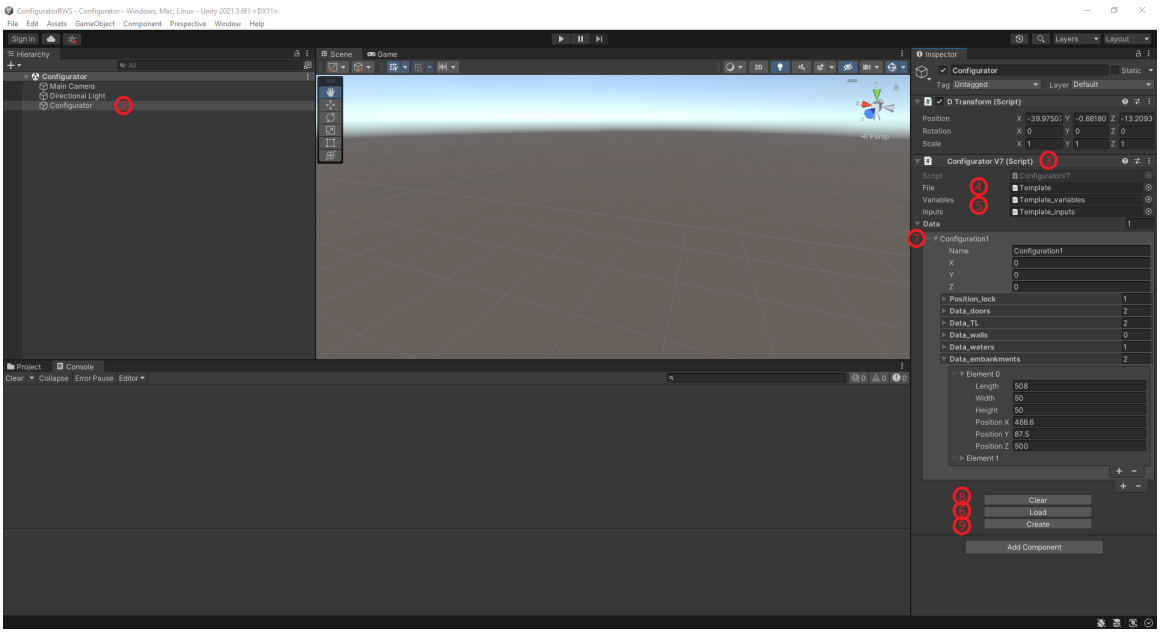

Figure 3.1: Unity environment

Before starting the DT the following steps need to be followed:

10. In the **Hierarchy** panel, locate the folders named *"PLC"* and *"TwinCAT"*. Make sure to deselect the folder that is not needed.

11. Find the folder named *"Pre Logic Simulator"* and locate the *"Pre Logic Simulator"* component within it. Enter a random number, such as "1", into the *"AMSNetID"* field.
12. Click *"Export Policy"*.
13. Remove the value from the *"AMSNetID"* field to make it empty again.
14. Click *"Export Policy"* once more.
15. Open TwinCAT and import the appropriate project corresponding to the designed configuration. Refer to the manual available at `https://cstweb.wtb.tue.nl/4tc00/festo/digital-twin/twincat.html` for detailed instructions.
16. Start TwinCAT.
17. Finally, start Unity.

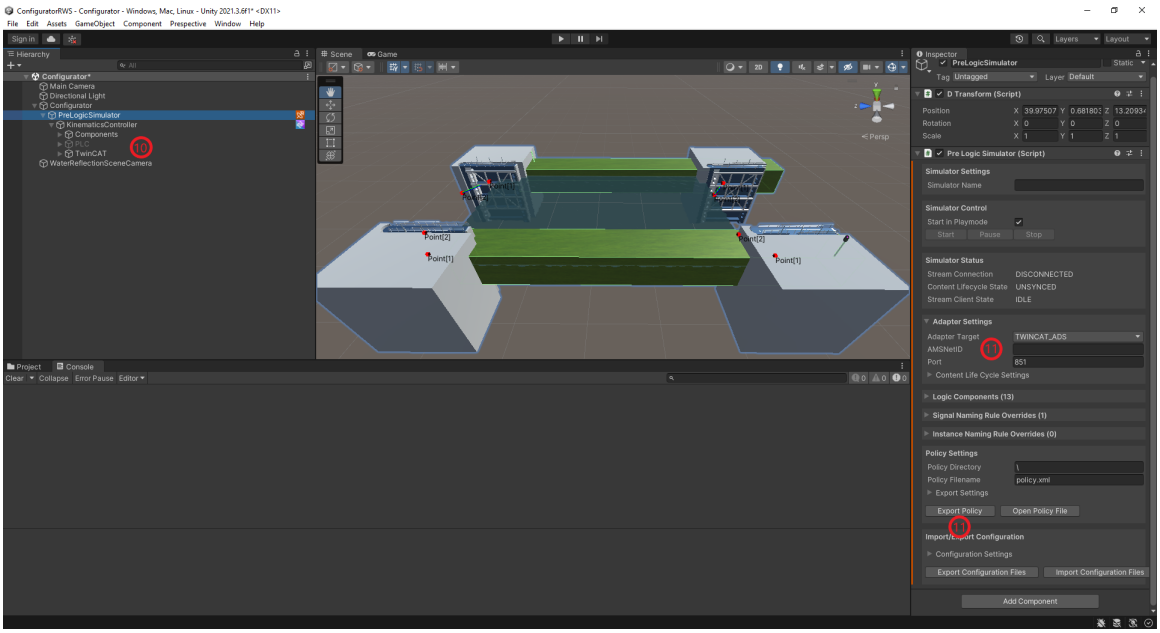

Figure 3.2: Configuration created