Use case 6:

Rapid mapping of a production system in a virtual environment

1. Introduction:

Welcome to this comprehensive training module, designed to guide you through the process of understanding, installing, and implementing a specific module within your system.

In this tutorial, you will find the following sections:

2. System Requirements: Before diving into the training, it's crucial to ensure that your system meets all technical requirements. This section will provide you with information on the required software, hardware tools, operating systems, libraries, and programming languages. Additionally, you will find useful links to documentation and tutorials, as well as sequence and architecture diagrams to help you better understand the module.
3. System Architecture: This section delves deeper into the structure and functionality of the module. You will learn more about sequence and architecture diagrams, and any other information deemed valuable for your specific module. We will also provide code snippets and links to facilitate hands-on learning.
4. Conclusion: In closing, we will express our gratitude for your participation and encourage you to explore the use case lectures to further enhance your understanding of the module and its applications.

By the end of this training, you will be well-equipped to tackle any challenges related to the module and integrate it into your projects.

2. System Requirements:

This section will outline the module's technical requirements and the necessary hardware and software tools.

Hardware requierments
The primary objective of this system is to rapidly create a digital twin model of a production system using simulation software. The module requires a mobile robot capable of scanning the production environment. Alternatively, a 3D camera, such as an Intel RealSense camera, or similar equipment can be used to produce a point cloud for scanning purposes. An example of importing a 3D point cloud to Visual Components can be found at
https://academy.visualcomponents.com/lessons/import-point-cloud/.

Software requierments:
Visual Components Premium 4.2+ is required as the platform for the digital twin model of the system. This industrial simulation software is ideal for simulating production systems and features built-in connectivity for the OPC UA server.

Cybersecurity:
The cybersecurity measures for this system and the Wire Arc Additive Manufacturing with Industrial Robots are similar:

Connect robots to a separate Wi-Fi router.
Implement endpoint protection on computers and shield ports.
Restrict computer access via Jump server or Team Viewer, with two-factor authentication.
Use SecurityOnion to monitor computers, including the OPC UA server host.
Employ encryption and signature for OPC UA server communication. Further cybersecurity measures
for the OPC UA server are in progress.

3. System Architecture:

This module introduces a method for quickly mapping a production system in a virtual environment.
The virtual model is generated using a simulation program, which offers the benefits of testing
various layouts, optimizing production, and conducting offline testing.

Part 1: Scanning the environment:

The initial step involves scanning the production environment. This mapping process requires
navigating a mobile robot throughout the production area to capture walls and machine placements.
In this module, we utilize the MiR100 to scan the environment.

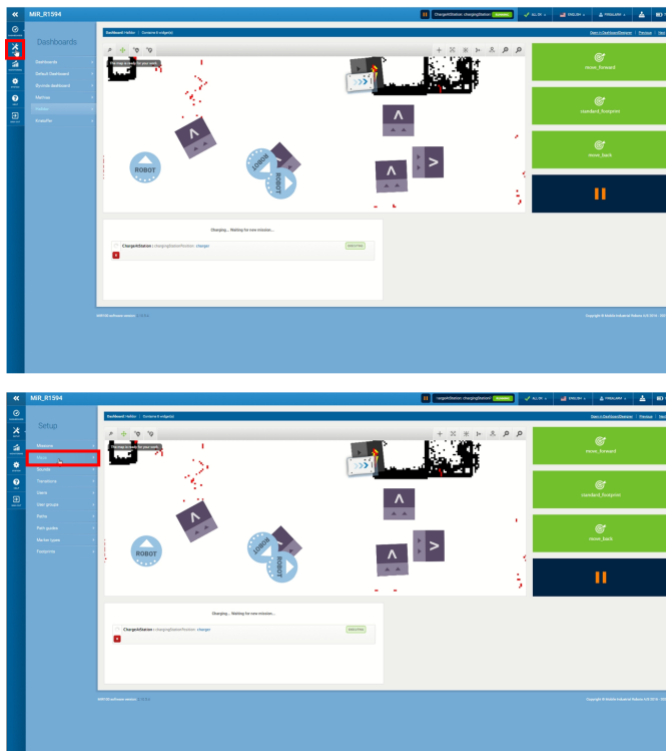First, connect to the MiR100 mobile robot and access the Map window:

Figure 1: Locate the Map window.

Create a new map by clicking the "Create map" button and filling out the required information, as
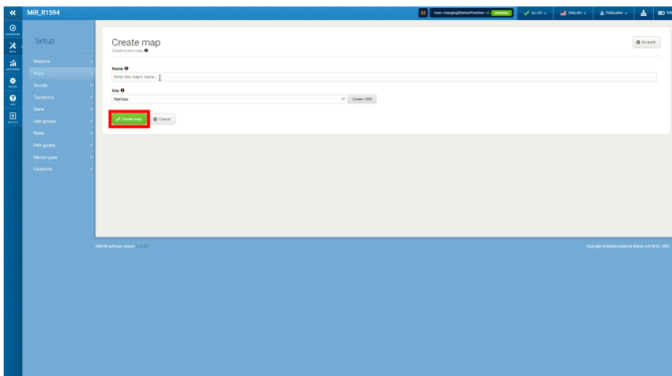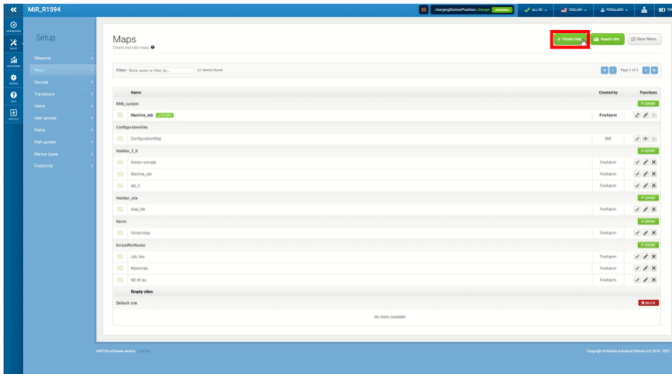demonstrated in Figure 2

Figure 2: Creating a new map.

To begin scanning, click the "..." button in the left-hand corner, followed by the "Record and append" button, as depicted in Figure 3
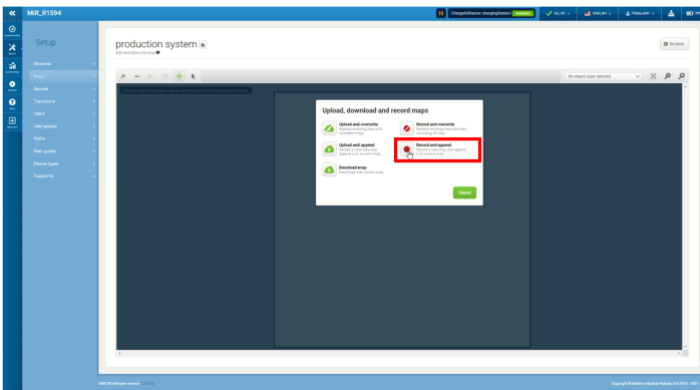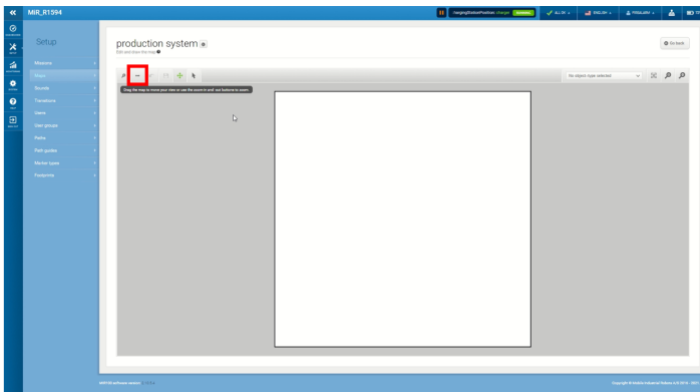
Figure 3: How to start recording a new map.

During the scanning process, ensure the mobile robot reaches all corners and walls. Additionally, remove or relocate any objects not fixed in the factory while scanning. After scanning the environment, press the square button as displayed in Figure 4
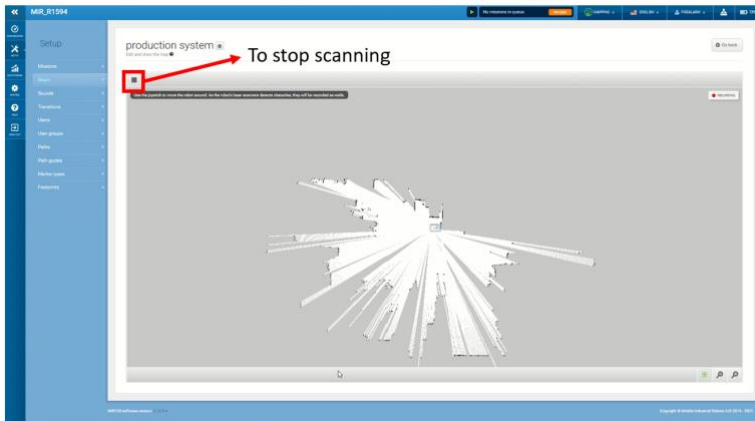

Figure 4: Illustrating the recording of a new map and how to stop it.

A map is then generated, which needs editing to remove non-stationary objects and any incorrect sensor readings. This is done using the "wall tool," as shown below:
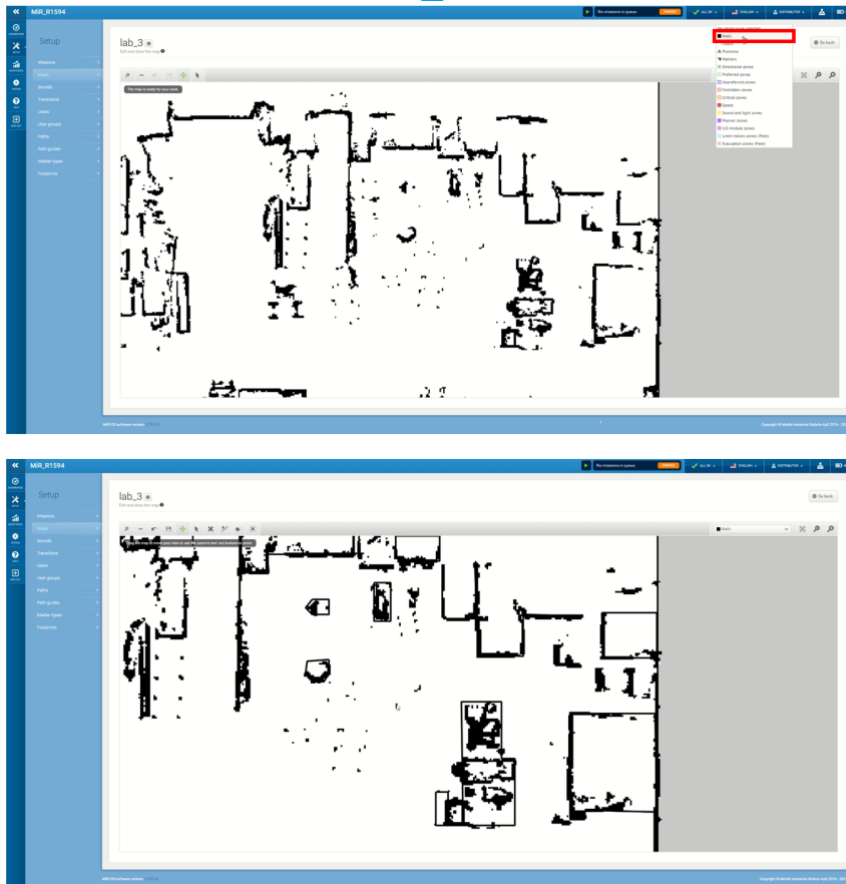
Figure 5: Cleaning up the map.

The map can then be exported from the MiR software as a PNG image.

Part 2: Creating the digital twin model

The second step is to use the scanned map of the factory to construct the digital twin. First, open a new environment in Visual Components. From the Visual Components library, place a "Picture Frame" on the floor and select the PNG image of the map, as illustrated in Figure 6.
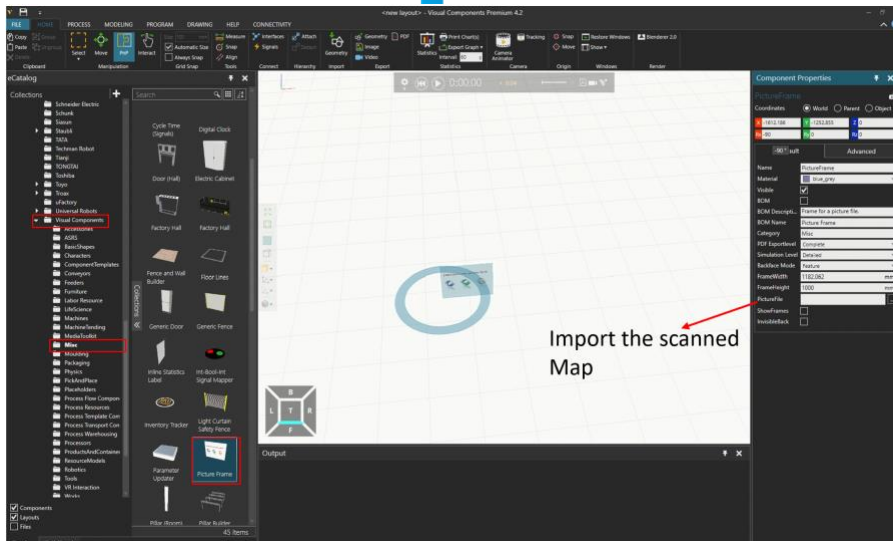
Figure 6: Show where the "PictureFrame" is.

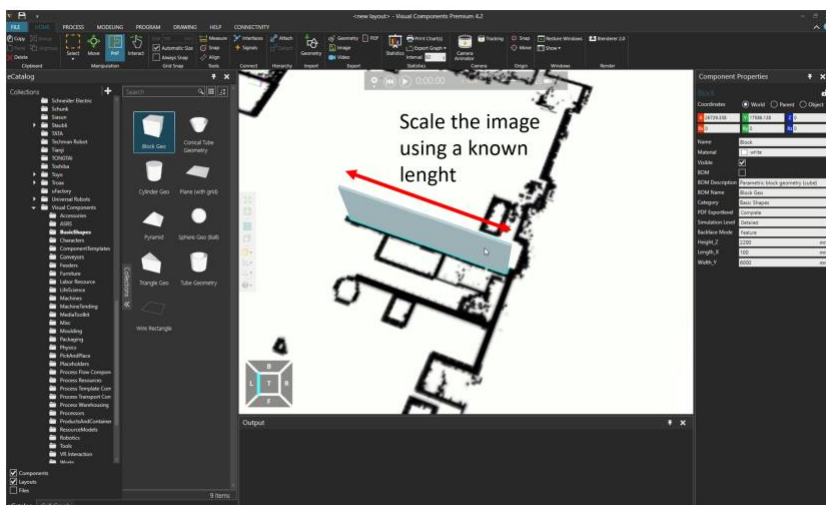Next, scale the picture frame using the walls or an object as a reference.

Figure 7: Scaling the imported image in Visual Components.

Lastly, use the image to position machines, walls, and robots accurately. Visual Components boasts an extensive library that includes nearly all modern robots and models for most standard production settings, such as walls, tables, CNC machines, and more. Additionally, CAD models can be imported into Visual Components as STL files. The Visual Components library or imported CAD files are placed in the correct position, and the digital twin model of the factory is built, as shown in Figure 8.
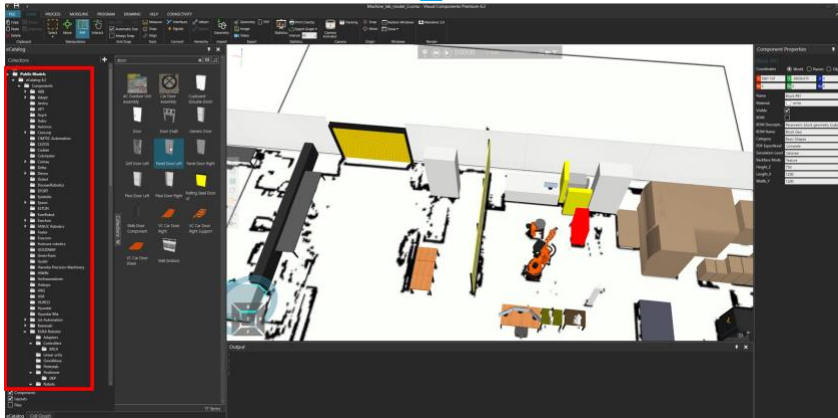
Figure 8: Building the digital model of the factory.

All steps for creating the digital twin in this tutorial are illustrated in Figure 9.
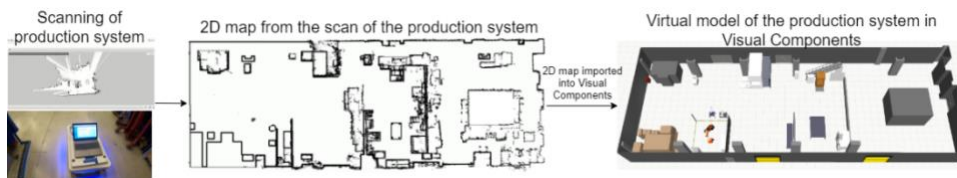

Figure 9: Process of creating the virtual environment

Once the digital twin model of the production environment is complete, it can be used for simulation, testing, and optimization of machine placements.

Tutorials on how to build simulations for the environment can be found at:
https://academy.visualcomponents.com/courses/

4. Conclusion:

In this training module, we have delved into the process of rapidly mapping a production system in a virtual environment. By following the outlined system requirements and the two-part system architecture, users can effectively generate a digital twin model of their production system using simulation software. This virtual model offers the benefits of testing various layouts, optimizing production, and conducting offline testing.

Throughout the module, we have explored the necessary hardware and software tools, as well as important cybersecurity measures. We have also examined the step-by-step process of scanning the production environment and creating a digital twin model using Visual Components Premium 4.2+. The resulting digital twin model can be used to simulate, test, and optimize machine placements, with additional tutorials and resources available at the Visual Components Academy.

By the end of this training, users will be well-equipped to tackle challenges related to rapid mapping and integrating the module into their projects. We encourage participants to continue exploring use case lectures to further enhance their understanding and application of this module.