Selmo

Analysis Process Assembler

This document describes the implementation of a demo plant using the Selmo method and is divided into five main areas:

1. Structuring the system:
   The plant is called **a "plant"** and is divided into one or more hardware zones **according to its safety requirements.** The control sequences are mapped in separate sequences to ensure clear and structured process modeling.

2. Activity analysis:
   The basic position of the machine defines the initial situation for the automatic sequence, which is activated by a defined start signal. Moving components, such as cylinders or motors, are monitored by sensors to precisely control the process steps.

3. Technology analysis:
   The essential technical components are explained, including **actuators, sensors, drives and operating elements** that are necessary for controlling the plant.

4. Functional analysis:
   The control of the movement sequences is described in detail. The interactions between the individual components and their monitoring by sensors and control logic are considered.

5. Process modeling in Selmo Studio:
   For implementation in Selmo Studio, it is recommended to use the preparatory tutorials in the **Selmo Knowledge Base.** In addition, tips are given on the structured modeling of the demo system in the Selmo Studio as well as on the optimal use of the Selmo functionalities.

For more information on the Selmo analysis process, visit our Knowledge Base.

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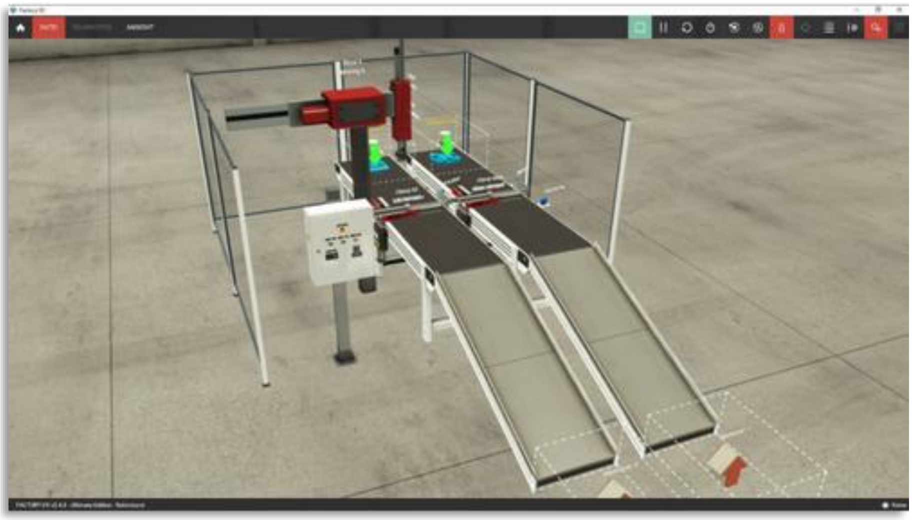
1. Structuring the system



The **structuring of the plant** is carried out according to Selmo's principles, whereby the stations and processes are divided into logical units (hardware zones and sequences).

The structure of the system is divided as follows:

> **Plant:** The entire assembly machine is called a "plant", which includes the complete plant.
>
> **Hardware zone:** The assembly machine is modeled as only one hardware zone, as the entire system only includes one protected area. Therefore, there is no need to implement multiple independent hardware zones.
>
> **Sequence:** The sequence of the assembly machine is modeled in 4 independent sequences. There is a process for the base and lid feeders, for the assembly process and one for the removal of the finished parts.

2.Activity analysis

An essential part of the process analysis is the definition of the **home position**, which ensures that all modules are correctly positioned and ready for operation. The basic position of the plant is defined as follows:

> The B1, B2 and B3 sensors indicate that the assembly machine's conveyor belt is empty. The 2-axis gantry robot is in home position and its gripper is empty (B4 not actuated) and open.

The clear definition of the basic position is essential, as it forms the basis for the safe start of the system. Only when the basic position has been clearly defined can the actual **automatic process** be described and implemented.

The automatic sequence of the system can be started by pressing the S1 button. After the start of the system. At the beginning, the assembly machine is loaded with the outputs lid conveyor B1 and basic conveyor B2. The parts (base and lid) are then moved to the limit by means of conveyor belts. When the parts are detected by the B1 and B2 sensors, the gantry robot moves to the position of the lid by means of the Z-axis and grips it. As soon as B4 has been detected by the sensor of the gripper, the robot moves to the position of the X-axis. Then the Z-axis is lowered and mounted on the part (floor). Then the axes X pos and Y pos are moved back to the home position. After the assembly of the two parts, the finished part is transported to the unloading position and can be unloaded there.

The process is repeated until the Stop S2 button is pressed.

An emergency stop switch S3 makes it possible to interrupt the process in the event of an emergency, whereupon automatic operation is stopped.

3. Technology analysis

Engine:

The components are each driven by electric motors, which are optimally adapted to their speed and power via gearboxes. Drum drives are often used in which the motor is integrated directly into the drive drum to save space. These are switched on and off via the individual outputs Mxx. The motors have no speed control or operating status monitoring.

Start-Button:

The start button is used to start the process. It is configured as a normally open contact, i.e. in idle mode, the voltage to the controller is interrupted and logic "0" is generated at the corresponding input. When the button is pressed, logic "1" is generated by passing on the voltage.

Stop Keys:

The stop button is used to interrupt the process. It is configured as a normally open contact, i.e. in idle mode, the voltage to the controller is interrupted and logic "0" is generated at the corresponding input. When the button is pressed, logic "1" is generated by passing on the voltage.

The sensor:

The sensors are proximity switches that detect objects without touching them. They usually work with magnetic, capacitive, inductive or optical principles to detect the presence of an object in its detection area.

Attack:

The stop cylinder is a pneumatic cylinder with an integrated mechanical stop that allows for a precise and repeatable end position. It is used here to position the components precisely so that they can be approached accurately and reproducibly by the gantry robot.

2-Achs Portal Robots:

The 2-axis gantry robot is an automated system that moves along two linear axes (X and Z) to perform precise positioning. It is used here for the pick-and-place of the lid and subsequent mounting on the base. Due to its gantry design, it is particularly suitable for large work areas and offers high repeatability. The target positions are stored in parameters and are determined when the machine is commissioned.

Claw:

The mounting gripper is a tool attached to the gantry robot to securely grip and position the lid during the assembly process. Depending on the application, it can be mechanically, pneumatically or electrically operated and is individually adapted to the geometry of the components. It also includes a sensor for part detection. In this way, safe gripping is monitored and detected at the pick-and-place if the part is lost on the way.

LED:

The LED is an electronic component that converts electrical energy into light. The abbreviation LED comes from the English "Light Emitting Diode". The LED´s are used to illuminate the buttons.

Emergency Stop Button:

The emergency stop button is a safety mechanism installed in the device to immediately stop operation in dangerous situations, thus preventing injury or damage. By pressing the emergency stop button, the elements are shut down and the process is interrupted. It is configured as an NC, i.e. in idle mode the voltage is passed on to the controller and logic "1" is created at the corresponding input. When the button is pressed, logic "0" is created by interrupting the voltage.

4.Functional analysis

This is followed by the functional analysis, in which the operation of the individual components and stations as well as their control requirements are examined in detail. The aim is to define the necessary functions in order to implement the previously developed process efficiently and precisely.

Load:

The two parts are transported separately to a stop via two conveyor belts M1 and M2. There they are detected by sensors B1 to B4 and clamped over a cylinder. This triggers the assembly process.

Assembly:

A 2-axis gantry robot picks up the lid and positions it on the base. The lid is gripped with a gripper, lifted and brought to the X-position base. There, the lid is placed on the base and the portal returns to its home position.

Driving out:

The assembled part is then transported away via the conveyor belt. To do this, the blockage is opened, and a sensor detects when the part is leaving. The conveyor belt is stopped again when it reaches the part detection sensor at the outlet.

Connection:

- The start button (S1) and the stop button are wired as normally open contacts and deliver a 0 signal when not actuated.
- The sensors (B1-B4) provide 1 signal when the parts are detected.
- The feedback of the positions of the axes is each a real value that is sent to the controller via analog inputs.

Ein-/Ausgangsbelegung

Die Ein- und Ausgänge des Modells sind wie folgt belegt (die Bezeichnung Ein- bzw. Ausgang bezieht sich dabei jeweils auf die angeschlossene Steuerung):

Eingang Nr.	Factory IO	PLC-Variablenname		Beschreibung
1	S1	I_Start	:BOOL;	S1 Start
2	S2	I _Stop	:BOOL;	S2 Stopp
3	S3	I _EStop	:BOOL;	S3 Not-Aus
4	B1	I _Lid_Conveyor1_Part_present	:BOOL;	B1 Deckelförderer 1 Teil vorh.
5	B2	I_Base_Conveyor1_Part_present	:BOOL;	B2 Basis-Förderer 1 Teil vorh.
6	B3	I_Base_Conveyor2_Part_present	:BOOL;	B3 Basis-Förderer 2 Teil vorh.
7	B4	I_Part_present_Gripper	:BOOL;	B4 Teil vorhanden Greifer
8	X pos	I_Actual_Pos_X	:REAL;	X-Ist-Position
9	Z pos	I_Actual_Pos_Z	:REAL;	Z-Ist-Position

Ausgang Nr.	Factory IO	PLC-Variablenname		Beschreibung
1	M1	O_Lid_Conveyor1_ON	:BOOL;	M1 Deckelförderer 1 EIN
2	M2	O_Base_Conveyor1_ON	:BOOL;	M3 Basis-Förderer 1 EIN
3	M3	O_Base_Conveyor2_ON	:BOOL;	M4 Basis-Förderer 2 EIN
4	Y4	O_Stop_Blade_2	:BOOL;	Y2 Anschlag oben anhalten
5	Y5	O_Close_Gipper	:BOOL;	Y3 Greifer schließen
6	Set X	O_Set_X	:REAL;	Position X
7	Set Z	O_Set_Z	:REAL;	Stellung Z
8	L1	O_Start_LED	:BOOL;	L1 Start-LED
9	L2	O_Stop_LED	:BOOL;	L2 Stopp-LED

5.Process Modeling in Selmo Studio

Relevant tutorials for the model are presented in the next chapter. To get an in-depth insight into the Selmo Studio, you can take the course "Sequence Logic Modelling - The New Way of PLC Programming - Start Now!". These tutorials will support you in practical application and deepen your understanding of working with the Selmo Studio.

To be able to carry out the course, all you have to do is click on the following link and book the course for free.

Link: Sequence Logic Modelling - The new way of PLC programming - Start now!

For a better overview and detailed analysis, the process model should be viewed directly in Selmo Studio, where the logic layer and the system layer are fully visible and comprehensible.

Before you move on to the practical implementation, you should also look at the instructions in the help center. This documentation will provide you with important basics and helpful tips for working in the Selmo Studio.

After reviewing the documentation, you can test the downloaded process model in real time. You can start the simulation of the plant and check the interaction between the process model and the digital twin. Use the created document as an aid to implement what you have learned independently in Selmo Studio.

Good luck with the practical application!