Selmo

Filling tank analysis process

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 in order 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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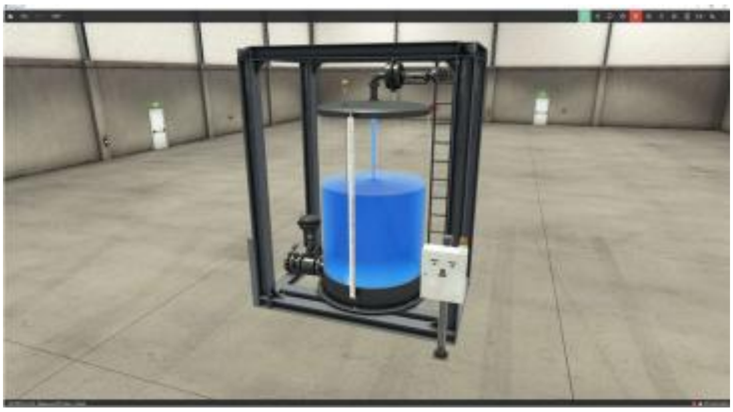
1. Structuring the system



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 filling tank is called a "plant", which includes the complete plant.
>
> **Hardware zone:** The filling tank 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 automatic flows.
>
> **Sequence:** The flow of the filling tank is modeled in a separate sequence.

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 filling tank is empty, which is signaled when the level is below 1%.
> The inlet valve and the drain valve are closed.

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 is started by pressing the S1 button. A filling tank is filled by two filling modes and then emptied again in a controlled manner. First you select 40% or 80% for the switch, this is then the selection for the fill level. Then press the Start button. The HMI shows whether you have selected 40% or 80%. If the decision is chosen correctly, the start button can be pressed again. The tank fills up to the desired selection. As soon as the tank has reached the desired level, the inlet valve closes, and the warning light comes on. To drain, press the Start button at the drain valve. The drain valve opens and you can use a potentiometer to set the desired flow. When the tank is drained to 1%, the drain valve closes and you can select 40% or 80% again with the switch. By pressing the stop button, the system always stops.

Due to the lack of feedback in the valves, the flow / changing fill level must be used to detect whether and how far the valves are open. This poses a possible risk, as conditions cannot be monitored directly or there may be delayed detection of errors in the system.

3. Technology analysis

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.

Rotary Flow Controller:

The flow rate controller controls the flow of the drain valve via a potentiometer that sends an analog signal of 0-10 mA to the PLC. The PLC reads this analog input value and scales it to a percentage value of 0-100%, which allows the flow to be precisely controlled. Based on this value, the PLC controls the drain valve according to the defined control characteristic curve in order to precisely set the desired flow rate.

Analog Encoder Level

The analogue level transmitter is a measuring device that measures the fill level of the container and sends an analogue value of 0-10 mA to the PLC. This corresponds to a fill level of 0-100% and is used to control the filling valve.

Stepless valve without position feedback:

This valve is used in conveyor systems and silos to continuously regulate or completely interrupt material flows. The control is via an analog signal of 0-10 mA, which allows the valve to be opened between 0-100%. However, there is no position feedback, so the current degree of opening is not directly recorded. The control is carried out exclusively via the output signal, without feedback on the actual valve position.

Warning light:

The warning lamp is a signal lamp that is controlled by the PLC via an output.

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.

Filling

Filling is carried out via the filling valve. After pressing the start button, the required fill level (40% or 80%) is first selected via the switch. The filling valve is then opened and the fill level is monitored via the B1 sensor. When the fill level is reached, the filling valve is closed and the warning light is switched on.

Empty

When the filling is finished, the Start Empty button can be used to start the emptying. The Drain valve is opened and remains open until the level gauge reaches a level below 1%.

Stop

By pressing the stop button, the system always stops. After acknowledging the notification, the process can be continued.

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Connection:

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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	Start Button 0	I_Start_Button_Discharge	:BOOL;	Start Taster Entleeren
2	Start	I_Start_Button	:BOOL;	Start Taster (Schließer)
3	Stop	I_Stop_Button	:BOOL;	Stopp Taster (Öffner)
4	Selector 0	I_Switch	:BOOL;	Schalter
5	Level Meter	I_Level_Meter	:REAL;	Sensor B1 (Füllstand)
6	Potentiometer 0	I_Poti	:REAL;	Drehregler Durchfluss

Ausgang Nr.	Factory IO	PLC-Variablenname		Beschreibung
1	Fill valve	O_Fill_Vave	:REAL;	Ventil Tank füllen
2	Discharge valve	O_Discharge_Vave	:REAL;	Ventil Tank entleeren
3	Warning Light 0	O_Warning_Light	:BOOL;	Warnlicht

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!