Selmo

Analysis Process Silo

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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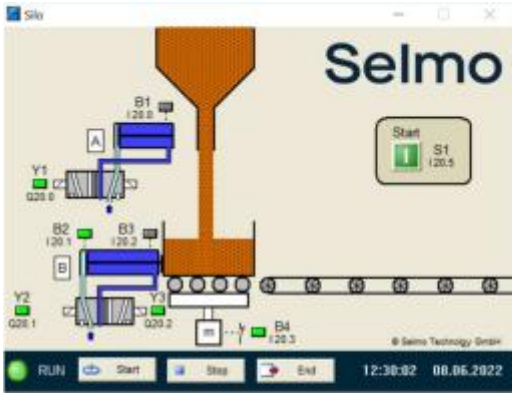
1. Structuring the system



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 silo is called a "plant", which includes the complete plant.
>
> **Hardware Zone:** The silo is modeled as a hardware zone only, as the entire plant only includes one protection area. Therefore, there is no need to implement multiple independent automatic flows.
>
> **Sequence:** The flow of the silo is modeled in a standalone 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:

> By pressing the limit switch B1, it is monitored that the shut-off regulator is in the extended position.
>
> By pressing the limit position switch B2, it is signalled that the extension device is in its rear end position. The non-active B4 sensor monitors that the transport container is not full.

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. After starting the drain, the gate valve cylinder A is opened and the container is filled with material from the silo. The B4 sensor monitors when the desired weight in the container has been reached. Once the desired weight has been reached, the silo is closed by the gate valve and monitored by means of end position B1. After a trickling time of 5 seconds, cylinder B pushes the container onto the conveyor belt, this cylinder is monitored via the end positions B2 and B3. Cylinder B then returns to its original position B2. This process is repeated 5 times. By pressing the start button S1, the process can be started again.

Due to the lack of end position monitoring in the gate valve for the open position of the silo, it can only be detected that the gate valve is not in the forward position. In the event of a defect in the slide valve, it could therefore be that the silo is not fully opened, as the gate valve does not move completely to the rear end position.

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.

Pneumatic Cylinder:

To control the pneumatic cylinders, 3/2-way solenoid valves are used, which have three connections and two switching states. These are double-acting cylinders, each with two valves for control for the home and work positions. The end position buttons are operated by retracting and extending the pneumatic cylinders in the respective position. They are configured as normally open contacts and generate logic "1" when the cylinder is in the end position.

Spring-reset pneumatic cylinder with only one end position monitoring:

Spring-returned pneumatic cylinders are single-sided cylinders that are moved in one direction with the help of compressed air, while an integrated spring takes over the restoring movement. They are used in applications where an automatic return to the starting position is required, such as security mechanisms or simple control tasks. For monitoring, the cylinder is equipped with an end position button. The end position button is operated by retracting and extending the pneumatic cylinder in the respective position. It is configured as a normally open and generates logic "1" when the cylinder is in the end position.

Weight sensor:

A weight sensor measures the force exerted on it and converts it into an electrical signal. This is usually done by means of strain gauges, which change their electrical resistance under load. This electrical signal is configured as a normally closed signal, i.e. in idle mode it generates logic "1" at the input of the controller and when the weight is reached, then logic "0" is generated at the input.

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:

The filling of the transport container is carried out via the gate valve cylinder A. It is moved over the spring-reset cylinder Y1, which opens the silo opening and the transport container is filled. When the target weight is reached, the sensor B4 switches to logic 0 and the gate valve closes the silo opening.

Slide-out:

The movement of the push-out device is realized by cylinder B. Y2 is controlled for the ejection movement, while the cylinder Y3 is responsible for the reverse movement when Y2 is switched off. The end positions of the extension device are monitored by switches B3 (end position extended) and B2 (end position retracted).

Connection:

- The limit switches (B1 – B3) are wired as normally open contacts and deliver a 0 signal when not actuated.
- The start button (S1) is also wired as a normally open contact.
- The weight sensor (B4) provides 0 signal when the weight has been reached.

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.	Boris	PLC-Variablenname		Beschreibung
1	S1	I_S1	:BOOL;	Start Taster (Schließer)
2	B1	I_B1	:BOOL;	Endschalter Zylinder A ausgefahren (Schließer)
3	B2	I_B2	:BOOL;	Endschalter Zylinder B eingefahren (Schließer)
4	B3	I_B3	:BOOL;	Endschalter Zylinder B ausgefahren (Schließer)
5	B4	I_B4	:BOOL;	Sensor Gewicht erreicht (Öffner)

Ausgang Nr.	Boris	PLC-Variablenname		Beschreibung
1	Y1	O_Y1	:BOOL;	Federrückgestellter Zylinder A einfahren
2	Y2	O_Y2	:BOOL;	Zylinder B ausfahren
3	Y3	O_Y3	:BOOL;	Zylinder B einfahren

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!