Selmo

Lifting Device 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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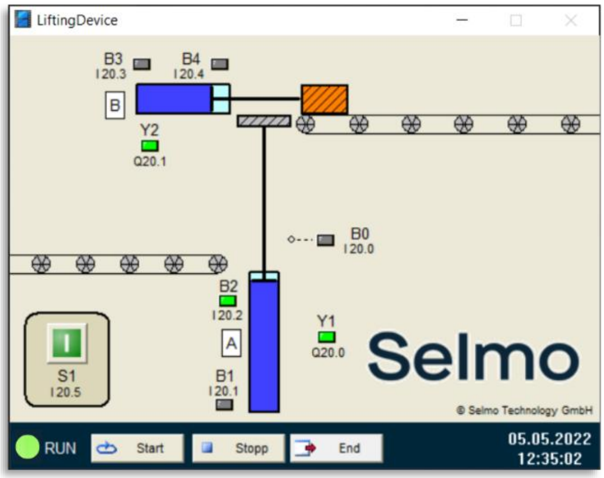
1. Structuring the system



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 lifting device is called a "plant", which includes the complete plant.
>
> **Hardware zone:** The hoist is modeled as a hardware zone only, as the entire facility only covers one protection area. Therefore, there is no need to implement multiple independent automatic flows.
>
> **Sequence:** The sequence of the lifting device 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 lifting device is in its lower end position, which is monitored by the actuated limit switch B1.
> The ejection device is in the retracted state, which is monitored by the actuated limit switch B3.
> The B0 light barrier of parcel detection must be free so that there is no parcel on the lifting device.

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 starting the system, a package is placed on the lower conveyor belt, which is then transported to the lifting device, cylinder A. If the light barrier B0 detects the package, it is transported upwards by the lifting device of cylinder A, which is monitored via the end position B2. When the package has reached the top, it is pushed onto the upper conveyor belt by the ejection cylinder B, which is monitored via the end layer B4. The package is transported further via the conveyor belt. Cylinder B retracts to the initial position B3 and cylinder A returns to the initial position B1. At the end, the packet is conveyed by a predefined time step of 5 seconds.

Since this application does not have a component detection system installed at the end of the conveyor belt, the conveying is simulated by means of a timer until the component is no longer on the conveyor belt.

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 switching the voltage forward.

Spring-returned pneumatic cylinders:

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 two end position buttons. 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.

Light barrier:

The photoelectric sensor is an optoelectronic sensor that detects objects by monitoring a beam of light that travels from a transmitter to a receiver. If the light beam is interrupted or reflected by a part, the sensor registers the presence of the object.

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.

Transfer:

The conveyor belt is moved by the M1 motor. The package is transported up to the lifting cylinder A so that it is detected by the B0 light barrier. Once the package has been lifted and ejected in the upper position, the conveyor belt continues to move the package until it is retrieved.

Lifting:

The movement of the lifting device is realized by cylinder A. The Y1 valve is controlled for the upward movement, while the spring return is responsible for the downward movement when the Y1 valve is switched off. The end positions of the hoist are monitored by switches B2 (upper end position) and B1 (lower end position).

Ejection:

The movement of the ejector is realized by cylinder B. The Y2 valve is controlled for the ejection movement, while the spring return is responsible for the reverse movement when the Y2 valve is switched off. The end positions of the ejector are monitored by switches B4 (end position extended) and B3 (end position retracted).

Connection:

- The limit switches (B1 – B4) are wired as normally open contacts and deliver a 0 signal when not actuated.
- The start button (S1) is wired as an NC contact.

- The light barrier (B0) provides a 1 signal when the packet interrupts the light beam.

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 (Öffner)
2	B0	I_B0	:BOOL;	Sensor Paket vorhanden (Schließer)
3	B1	I_B1	:BOOL;	Endschalter Zylinder 1 eingefahren (Schließer)
4	B2	I_B2	:BOOL;	Endschalter Zylinder 1 ausgefahren (Schließer)
5	B3	I_B3	:BOOL;	Endschalter Zylinder 2 eingefahren (Schließer)
6	B4	I_B4	:BOOL;	Endschalter Zylinder 2 ausgefahren (Schließer)

Ausgang Nr.	Boris	PLC-Variablenname		Beschreibung
1	Y1	O_Y1	:BOOL;	Federrückgestellter Zylinder 1 ausfahren
2	Y2	O_Y2	:BOOL;	Federrückgestellter Zylinder 2 ausfahren
3	M1	O_M1	:BOOL;	Motor Förderband

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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!