Selmo

Bending 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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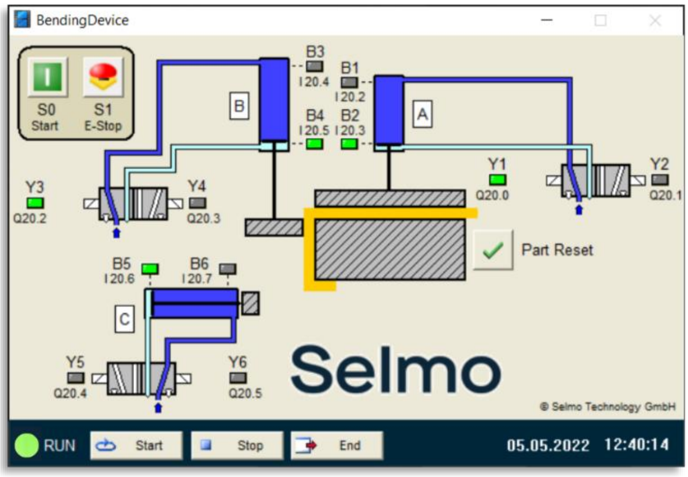
1. Structuring the system



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

> There is an unmachined workpiece on the bending device. The clamping cylinders A and the bending cylinders B and C are in the retracted state. (B1, B3 and B5 active) The E-Stop S1 must not be activated.

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 S0 button. At the beginning of the process, the workpiece is clamped via cylinder A and monitored via the end position B2. This is followed by cylinder B, which bends the workpiece further, this cylinder is monitored via the end position B4. After reaching the end position B4, the workpiece was bent, the cylinder remains in the same position. Cylinder C then bends the workpiece into the finished position. Cylinder C is monitored via the end position B6 and after reaching the end position B6, the workpiece is fully bent. In order to reach the home position again, the cylinders move back in reverse order after the bending process and the workpiece can be removed.

The "Part Reset" button allows the workpiece to be returned to its original shape and the process can be restarted by pressing the S0 button.

An emergency stop switch S1 makes it possible to interrupt the process in the event of an emergency, whereupon automatic operation is stopped.

Since there is no component recognition in this application, the workpiece is simulated.

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.

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.

Clamping and bending

The workpiece is clamped by means of cylinder A. The cylinder is controlled by means of a valve Y1. It must be ensured that the cylinder remains extended, this is continuously monitored with B2. Cylinder B bends the workpiece by controlling the Y5 valve. It must be ensured that the cylinder remains extended, this is continuously monitored with B4. After this bending process, the next cylinder C is controlled, this is done by means of valve Y5 and is monitored by the end position B6. After the bending process is completed, the cylinders (A, B and C) can move back to their home position. Cylinder C retracts first, by controlling the valve Y6, then cylinder B retracts by controlling the valve Y4. Finally, cylinder A retracts by controlling the valve Y2.

Pressing the emergency stop button S1 leads to the immediate shutdown of automatic operation. By pressing the reset button in the model, the sheet metal is reset to its original shape.

Connection:

- The limit switches (B1 – B6) are wired as normally open contacts and deliver a 0 signal when not actuated.
- The start button (S0) is also wired as a normally open contact.
- The emergency stop button (S1) is wired as an NC contact. It provides a 1 signal in the normal unactuated state.

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	S0	I_S0	:BOOL;	Start Taster (Schließer)
2	S1	I_S1	:BOOL;	E-Stop (Öffner)
3	B1	I_B1	:BOOL;	Endschalter Zylinder A eingefahren (Schließer)
4	B2	I_B2	:BOOL;	Endschalter Zylinder A ausgefahren (Schließer)
5	B3	I_B3	:BOOL;	Endschalter Zylinder B eingefahren (Schließer)
6	B4	I_B4	:BOOL;	Endschalter Zylinder B ausgefahren (Schließer)
7	B5	I_B5	:BOOL;	Endschalter Zylinder C eingefahren (Schließer)
8	B6	I_B6	:BOOL;	Endschalter Zylinder C ausgefahren (Schließer)

Ausgang Nr.	Boris	PLC-Variablenname		Beschreibung
1	Y1	O_Y1	:BOOL;	Zylinder A ausfahren
2	Y2	O_Y2	:BOOL;	Zylinder A einfahren
3	Y3	O_Y3	:BOOL;	Zylinder B ausfahren
4	Y4	O_Y4	:BOOL;	Zylinder B einfahren
5	Y5	O_Y5	:BOOL;	Zylinder C ausfahren
6	Y6	O_Y6	:BOOL;	Zylinder C 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!