Preliminary Design Review

MISCE project

Mechatronics for Improving and Standardizing Competences in Engineering

Competence: Automation Technology

Workgroup: University of Cagliari

University of Cassino and Southern Lazio

This document is the Preliminary Design Review of the technical competence ‘Automation Technology’. Its briefly contains the experimental platform analysed in MISCE project, to be designed and standardised for improving the acquisition level of this competence on engineering degrees.

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Index of contents

Index of figures

Index of tables

1 Competence and skills

The conceptual design presented in this document is referred to the technical competence:

C1. Automation Technology

which related skills are (see Table I):

Table I. Skills of Automation Technology

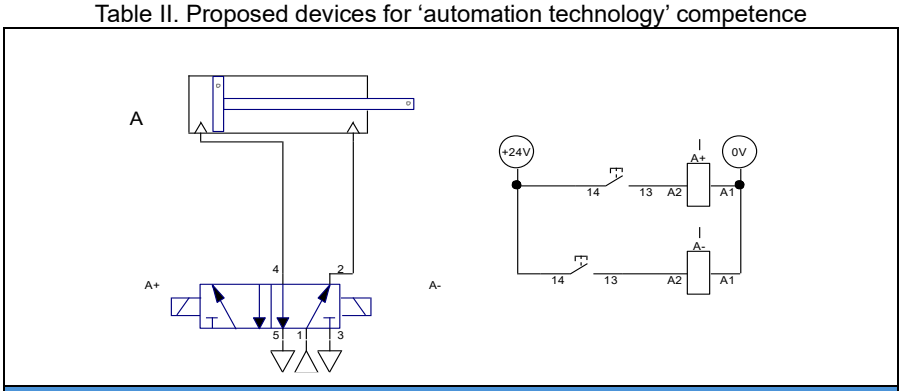
S1.1.	To know the main electric/pneumatic and hydraulics elements
S1.2.	To be able to design the functional behavior of the system
S1.3.	To be able to understand the technical documentation of a project/product
S1.4.	To program the functional behavior of the device
S1.5.	To debug the final planned behaviour of the system

The different conceptual designs presented in this document have been analysed to ensure that can improve the acquisition level of the aforementioned competence.

2 Experimental proposals

For this application, the MISCE project proposes the use of a modular test bench composed of three double-acting pneumatic cylinders, each equipped with two position sensors, and controlled via a Siemens PLC. For this competence, MISCE project proposes the joint use of the devices in Table II, together with their corresponding teaching materials.

Table II. Proposed devices for 'automation technology' competence



Actuation of a double effect pneumatic cylinder

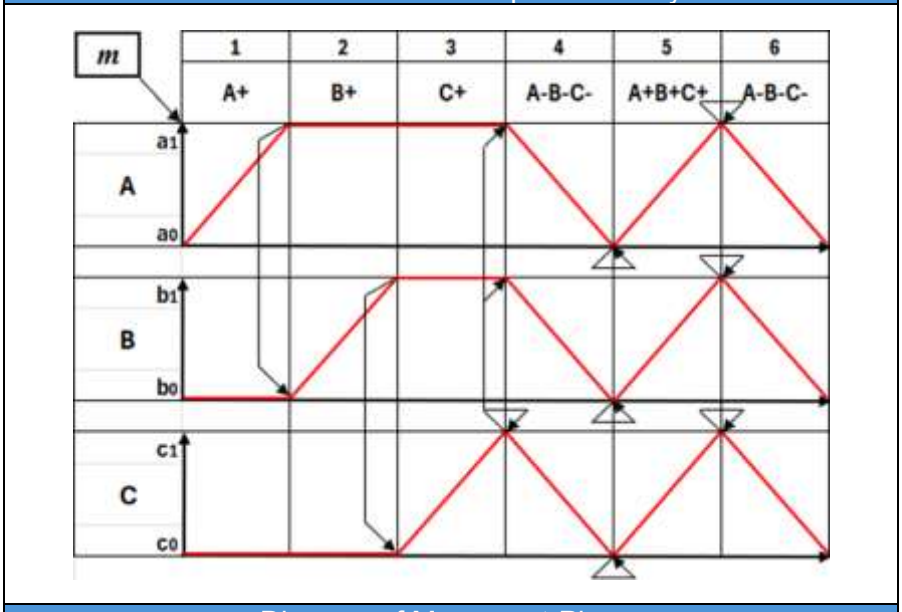


Diagram of Movement-Phase

In the following sections each device is detailed explained.

2.1 Actuation of a double effect pneumatic cylinder

The actuation of the double-acting pneumatic cylinders is widely used in teaching environments focused on automation technology. In this setup, three double-acting pneumatic cylinders are controlled by means of a PLC and a set of electrically actuated directional control valves: two 5/2 monostable valves for cylinders A and B, and two 3/2 monostable valves for cylinder C. The actuation is triggered by a monostable push button, initiating a predefined cycle composed of seven operational phases (see Figure 1).

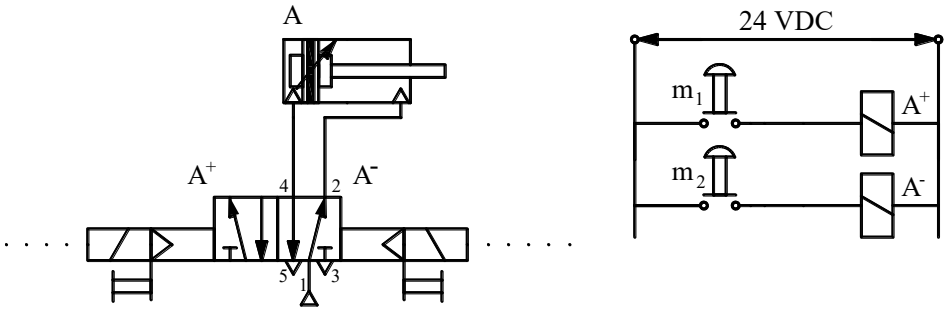


Figure 1 Double effect pneumatic cylinder

This system allows the analysis of more advanced pneumatic sequences and logic programming using real industrial components. The control unit, based on a Siemens PLC, enables integration with complex logic operations and facilitates hands-on learning in sequencing, feedback management from limit switches, and synchronized movements.
This platform goes beyond simple cylinder actuation, providing a comprehensive environment for studying electro-pneumatic automation, combining both hardware and programming skills in a realistic test bed.

2.2 Diagram of Movement-Phase

Using the experimental platform described above, it is possible to generate and analyze a wide range of movement-phase diagrams corresponding to various automation sequences. In this specific case, the control objective is to implement a six-phase sequence involving three double-acting cylinders, each equipped with two position sensors.
The experimental setup, combined with the Siemens PLC, allows for the programming and real-time monitoring of multiple actuation patterns, offering a highly instructive environment for understanding the logic behind pneumatic automation cycles (see Figure 2).

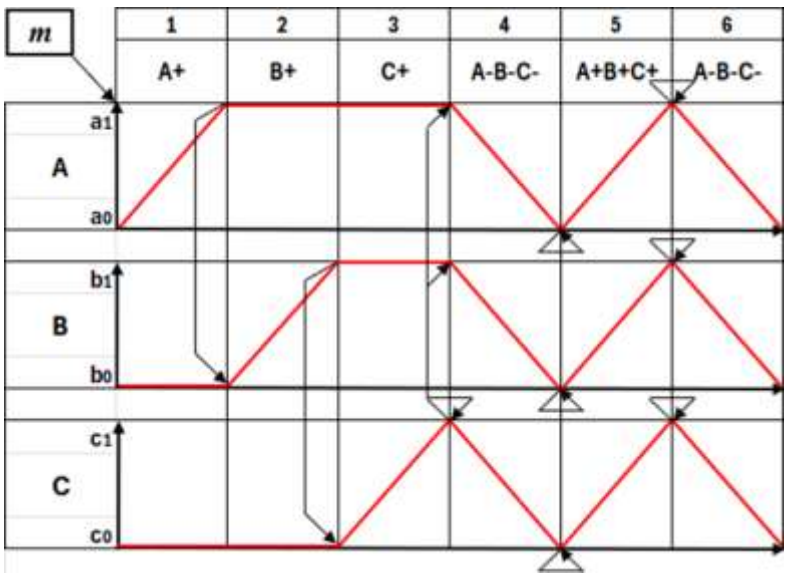


Figure 2. Generation of a suitable “Movement-Phase” displacement

This platform extends the basic pneumatic functionality by introducing synchronized and cyclic behaviour, enriching the training experience with more advanced control capabilities.

3 Competence and skills analyses

Table III summarises the competence and skills analyses of the proposed experimental platform attending to the contribution of acquisition of the technical competence ‘automation technology’ and their corresponding skills in Table I.

Table III. Contribution of each proposed platform to automation technology competence and its corresponding skills

Platform	S1.1	S1.2	S1.3	S1.4	S1.5	**Overall competence contribution**
Actuation of a single acting pneumatic cylinder	 Know the main electric/pneumatic and hydraulics elements	 To be able to design the functional behaviour of the system.	 Ability to understand the technical documentation of a project/product.	 Ability to program the functional behaviour of the device	 Capability to debug the final planned behaviour of the system	 4.2
Actuation of a double acting pneumatic cylinder	 Know the main electric/pneumatic and hydraulics elements.	 To be able to design the functional behaviour of the system.	 Ability to understand the technical documentation of a project/product.	 Ability to program the functional behaviour of the device	 Capability to debug the final planned behaviour of the system.	 3.6
Movement-Phase" displacement	 Know the main electric/pneumatic and hydraulics elements	 To be able to design the functional behaviour of the system	 Ability to understand the technical documentation of a project/product.	 Ability to program the functional behaviour of the device	 Capability to debug the final planned behaviour of the system	 4.0

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