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Specialty: Automatic and system

Automation of setting in packaging case based on PLC

Presented by

BELKHIRAT Amal

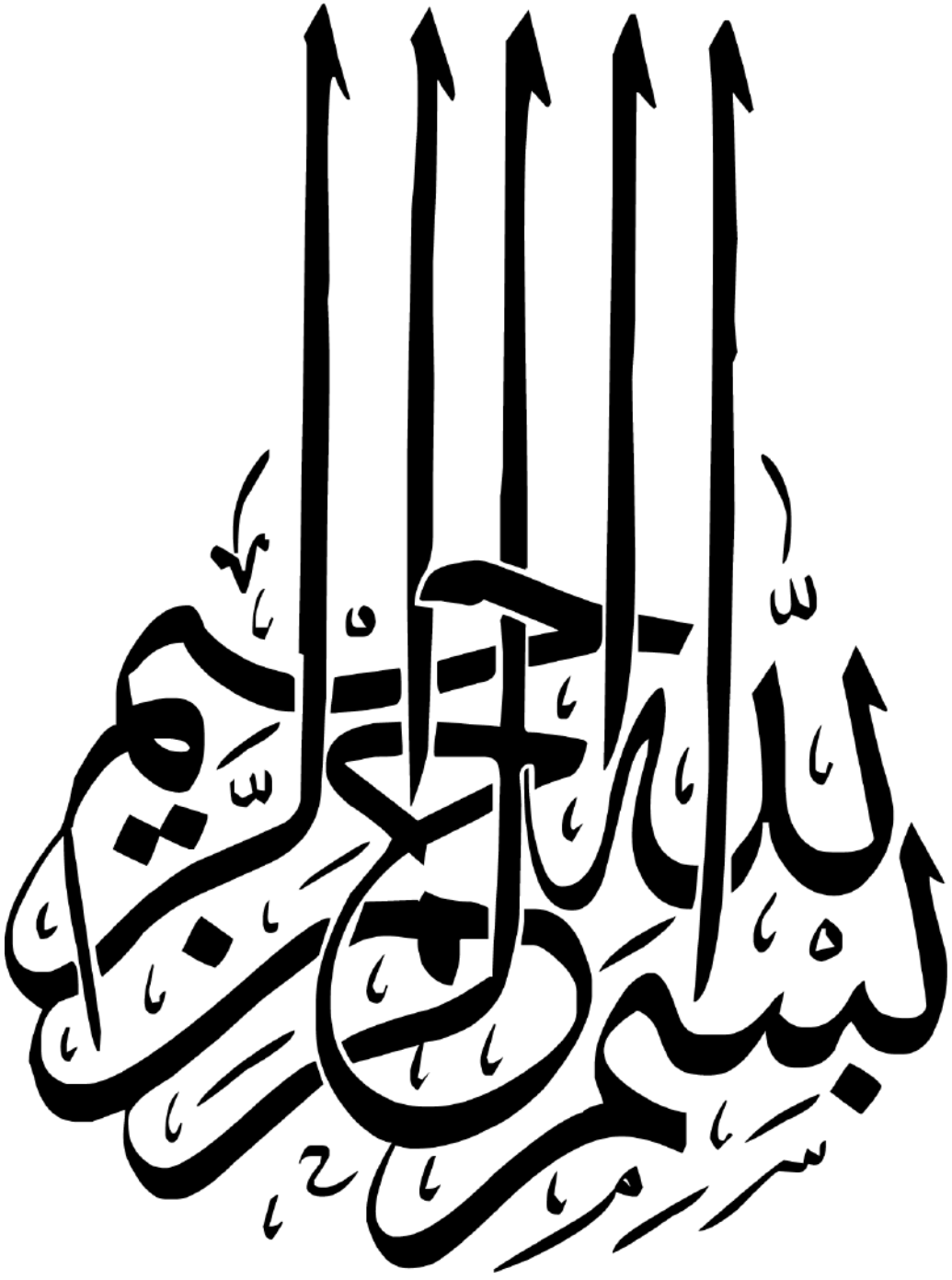
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Promotion 2021


بسم الله الرحمن الرحيم

Thanks

First, we would like to thank ALLAH the almighty and merciful, who has given us the strength and the patience to do this modestwork.

Secondly, we would like to thank our supervisors

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for their invaluable advices and help during the whole workperiod.

Our warm thanks also go to the members of the jury for the interest they took in our research by agreeing to examine our workand enrich it with their proposals.

Dedication

I thank ALLAH for giving me the strength, willingness and the intelligence to be patient in my studies.I dedicate this work to

- My dear parents who helped me a lot and who sacrificed themselves for my good and who has encouraged and supported me throughout my life and during my studies.
- To my brothers Abdelhak and Abderzak
- To my dear friend Cheima, where I find the deal I needed and all her family.
- To my comrades, and friends, also who have contributed directly or indirectly to the achievement of this work
- To all SAIDAL maintenance team

BELKHIRAT Amal

Dedication

This modest work is dedicated in the first place to ALLAH, who gives me the power and capacity to do it.

To my dear's parents who have provided me with their encouragement, love and understanding patience, support, encouragement, they were the secret of my success.

To my dears brothers Khier-Eddine, Ghalib, to my sisters Aya, Khaoula,Toria and lila.

To my friend Amal and her family and all my other friends

To all my colleagues promotion of automation and systems 2021, to all YAHIA FARES university community

To SAILDAL maintenance group

BOUSSENA Cheima

الملخص :

تعتبر الأنظمة الآلية أمر في غاية الأهمية في الصناعة في مختلف مجالاتها بحيث أصبح استعمالها أكثر شيوعا مما جعلها رائدة في عالم التعبئة بحيث يقوم المبرمج الآلي الصناعي بالتحكم في نظام الآلة الصناعية وتوجيهها.

يهدف المشروع الذي قمنا به إلى تطوير وتحسين عمل آلة التعبئة التي كانت تعتمد على البطاقات الكترونية في نظام التحكم الآلي (تتطلب البطاقات الإلكترونية وقتًا للتعامل مع أي مشكلة ومتخصص ...) لذلك قمنا باستبدالها بمبرمج ألي وذلك لما يتوافق مع تطور الصناعة العالمية.

الكلمات المفتاحية :الآلية، مبرمج ألي صناعي، البطاقات الكترونية، نظام التحكم الآلي.

Résumé :

L'automatisation de l'industrie est devenue la tendance mondiale en matière de mise enétuis et l'une des plus utilisées dans l'industrie, de plus en plus d'entreprises optant pour l'automatisation. Cette recherche est consacrée à l'utilisation du système de contrôle automatique dans le système de la machine de traitement (Les cartes électroniques nécessitent du temps pour traiter tout problème et un spécialiste), le système de contrôle jouant un rôle majeur dans le contrôle de tous les aspects de cette recherche. Le projet de fin d'étude concerne la conception et développement d'un système mise en étuis automatisé.

Mots-clés : Automatisation, API, système automatisé, Les cartes électroniques.

Abstract

Industry automation has become the global trend in packaging and one of the most used in the industry, with more and more companies opting for automation. This research is devoted to the use of the automatic control system in the processing machine system (Electronic cards require time to deal with any issue and a specialist), the control system playing a major role in controlling all aspects of this research. The end of study project concerns the design and development of an automated packaging system.

Key words Automation, Control, Process, Electronic cards.

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Abbreviations list

API: Automate **P**rogrammable **I**ndustrial.

AC: Alternating **C**urrent.

CPU: Central **P**rocessing **U**nit.

DC: Direct **C**urrent.

FBD: Function **B**lock **D**iagram.

GRAFCET: GRAphe **F**onctionnel de **C**ommande des **E**tapes et **T**ransitions.

HMI: Human **M**achine **I**nterface.

IL: Instruction **L**ist.

IN: Inputs.

IT: Information **T**echnology.

LD: Ladder **D**iagram.

LCD: Liquid **C**rystal **D**isplay.

NO: Normally **O**pen.

NC: Normally **C**losed.

OUT: Outputs.

PC: Personal **C**omputer.

PLC: Programmable **L**ogic **C**ontroller.

ST: Structured **T**ext**.**

SFC: Sequential **F**unction **C**hart.

PREAMBLE

COMPANY PRESENTATION

1. Company presentation

Group SAIDAL is the largest pharmaceutical company in Algeria and in Africa.

SAIDAL is a joint-stack company with a capital of 2.500 millions DA in Algeria, 80% of it is for the state and the rest are for institutional investors and natural persons [1]

صيدال
SAIDAL

Figure.1. SAIDA logo

2. Their mission

The first mission of SAIDAL consists in providing patients with a rich and diverse range of medicaments.

The position as a public company also imparts of assisting the public health policy in the development of pharmaceutical industry by orienting investment toward meeting the needs of population.

3. Their values

The fundamental values of citizen are solidarity, equity, integrity, transparency and commitment.

4. Their infrastructures

- Six production sites
- Three regional distribution centers
- A research and development center
- A center dedicated to Bioequivalence studies



Figure.2. Different stations

5. Their products

The range of SAIDAL products comprehends more than 200 products divided into 20therapeutic classes. [2]

6. Geographical localization



Figure.3. Geographic situation of SAIDAL MEDEA [3]

General introduction

General introduction

Automation has spread to all production activities, as long as an industry than in service activities. Whatever it field of application and the techniques it uses, automation has constantly developed with the sole aim of reducing the arduousness of human labor, increasing safety, and improving labor productivity.

The increasing use of automation has profoundly influenced daily life and the general development of society, throughout the history, this automation has fact allowed a constant increase in productivity (quantity and quality), which considerably reduced the working time required for production.

The development of technology and the complexity of electrical diagrams have made it possible to replace functioning blocks with microcontrollers; they are a revolution in the world of integrated circuits because they are suitable for performing many functions, their use no longer limited to inputs/output controls, but also for much more complexes application.

Our thesis aims to offer a solution to automate the caser machine and study ZELIO industrial programmable logic controller, we focused to create the right program for our system, the caser machine installed in SAIDAL unite in MEDEA, of practical internship lasting 2 months for two days in week, from the step of synthesis of detailed specification of the real-time of the CAM machine until the step of simulation and compilation of the program on the PLC, accompanied by our supervisor Mr. MOULOUAD Amine.

This thesis divided into three chapters

The **first chapter** is about processes description of the automat systems and hardware.

In the **second chapter**, we will present the CAM machine that we work on and its operating

For the **last chapter**, we will present programming and the simulation of the machine using ZELIO software, and we will see our PLC displays, and we will finish the work with a general conclusion.

Chapter I

Process description

I.1. Introduction

Industrial automation is the use of control systems, such as computers or robots, and informatics technologies for handling different processes and machineries in an industry to replace a human being. It's the second step beyond mechanization in the scope of industrialization.

Industry automation has become the global trend in manufacturing, packaging and one of the most used in the industry, with more and more companies opting for automation.

I.2. Histories

When we hear the word 'automation' now, our minds automatically go to advanced technology such as artificial intelligence, machine learning, and robotics. However, the history of automation technology is much deeper than just the extensions of automation that used in the workplace today. Automation defined as the creation of technology and itsapplication in order to control and monitor the production and delivery of various goods and services. The idea of automation is not necessarily a modern one, as the theory behind utilizing automation technology has been around for centuries, although it has become more specific as well as refined to fit certain industries in the last 100 years.

Throughout history, there is evidence of different groups of people attempting to use automation to solve everyday problem they faced, from miners around the 11th century to workers in the 17th century. However, the period when automation really began to take off was the industrial revolution. The increase in demand for things such as paper and cotton caused a change in the production of these items, with an immense amount of emphasis placed on extreme efficiency and production. In the textile industry, innovations such as the cotton gin became mechanized, powered by steam and water, allowing for greater production yields. In the paper industry, the Fourdrinier was invented, a machine that was able to make continuous sheets of paper, and eventually led to the development of making continuous rolling sheets of iron and other metals. Huge jumps in other fields such as transportation and communication were also made, leading to an increase in even more automation. In fact, a little later on, the term 'automation' itself was coined in 1946, due to the rapid rise of the automobile industry and the increased use of automatic devices in manufacturing as well as production. D.S Harder, an engineer who worked for Ford Motor Company, is credited with the origin of the word.

Overall, as the information presented shows, automation has a deep and rich history that spans

over the centuries. The main uses of automation prior to the 20th and 21st century have been in industrial fields, and have only more recently been incorporated into the IT word. The drivers of all automation technology, however, have always been similar. With industrial automation, the goal was always clear; to improve the efficiency of manufacturing a variety of items.

With IT automation, the goal is to improve efficiency bay creating a process that is self- sufficient and replaces an IT worker's manual labor in data centers and cloud deployments. The parallels are clear, and they show why automation will always be prevalent in society. Developing technology to lessen the burden on human workers, increase business efficiency and make our lives easier in terms of reducing manual labor is something that has been important to us for centuries, and will continue to make its impact in the future. [4]

I.3. Definition of automatism

Is a subset of a machine, intended to replace the action of the human being in generally simpleand repetitive tasks, demanding precision and rigor. We passed of a so-called manual system, to a mechanized system, then automated system.

In industry, automatisms have become essential; they allow performing daily the most thankless, repetitive and dangerous tasks. Sometimes, these automatisms are so fast andprecise, that they carry out action impossible for a human being. Automation is therefore synonymous with productivity and security. [5]

I.4. Automated systems

A production system will be automated, when it can autonomously manage a pre-established work cycle which breaks down into sequences or steps. Automation of a process (industrial equipment) consists in ensuring its control by a device technological. [5]

I.4.1. The characteristics of an automated system

Automation is a device that allows machines or installations to operate automatically. A well-designed automation

- Considerably simplifies human work which, freed from the machine, can be devote tomore noble activities.
- Reduces complex tasks, annoying or undesirable by having them carried out by themachine.
- Facilitates manufacturing changes by allowing a quantity or type to be changed from

production to another.

- Improves product quality by slave the machine to manufacturing criteria and tolerancesthat will be respected over time.
- Increases production as well as productivity.
- Saves material energy.
- Increases safety.
- Controls and protects installation and machines. [5]

I.4.2. Objective of automation

The objectives of automation system are

- Increase system productivity and improve product quality.
- Increase staff safety.
- Control and protect installation and machines.
- Improve production flexibility.
- Eliminate complex, dangerous, painful or unwanted tasks by making them executed by the machine. [5]

I.5. Structure of automated system

Any automated system made up of three main parts

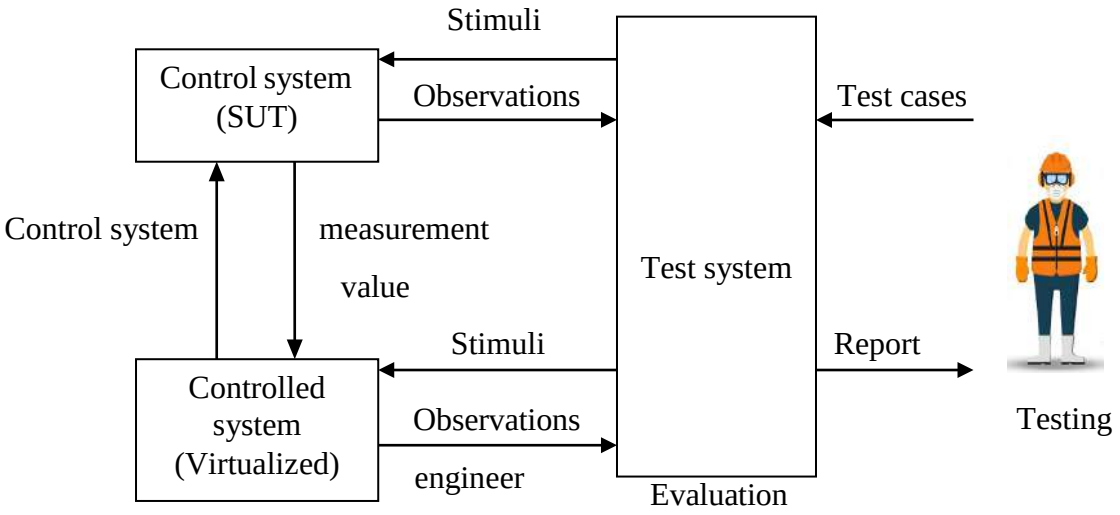


Figure.I.1. Structure of automated system.

I.5.1. Disconnect switch

Disconnect switch or isolator switch that use to ensure that electrical circuit is completely re-energized for service or maintenance. They used only for breaking the circuit and are often found in electrical distribution and industrial application, where machinery must have its source of driving power removed for adjustment or repair.

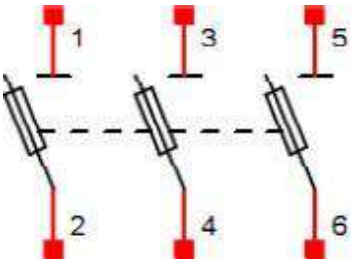
Disconnects can be manual or by motor operating and may be paired with an ear-thing switch to ground the portion that has been isolated from the system for ensuring the safety of equipment and the personnel working on it.



Four-pole disconnected Fuse



Three-pole disconnected rotary control



Symbol

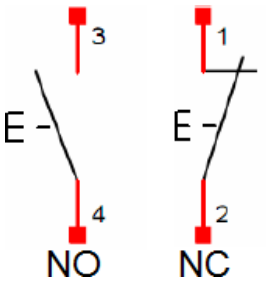
Figure.I.2. Different disconnect switch

I.5.2. Push-button

A push-button or a simple switch mechanism to control some aspect of a machine or a process, Buttons are typically made by out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, just to be easily depressed or pushed. Buttoned are most often biased switches, although many un-biased buttons still require a spring to return to their un-pushed state.

Terms for the ‘pushing’ of a button include pressing, depressing, mashing, slapping, hitting, and punching.





Emergency stop button Symbol

Figure.I.3. Different push-button

I.5.3.Control part

This part draws up the orders necessary for the execution of the process, depending on the information it receives from the operational part. It returns them to direction of operative part.

The control part is in the form of

- Electronic card.
- PLC industrial programmable controllers.
- Calculator (microcomputer).

I.5.4. Operative part

I.5.4.1. Contactor

A contactor is an electrical device, which's used for switching electrical circuit on or off.

It's considered to be a special type of relay. However, the basic difference between the relay and contactor is that the contactor used in application with higher current carrying capacity, whereas the relay used for lower current application. Contactor can be field mounted easily and are compact in size. Generally, these electrical devices feature multiple contacts. These contacts are in most normally open and provide operating power to load when the contactor coil is energized. Contactor is the most commonly used for controlling electric motors.



Figure.I.4. Contactor

I.5.4.2. Electro-pneumatic distributor

Electro-pneumatic distributor controls the establishment and the interruption of the circulationof pneumatic energy between the generator source and the pneumatic actuator.

This distributor is therefore intend to direct the pressurized fluid towards the actuator. In the reverse direction, and by another route, it ensures the pressures-free return to the free air (exhaust). [6]



Figure.I.5. Electro-pneumatic distributor

I.5.4.3. Pneumatic distributor

Pneumatic distributors are part of the energy chain, they distribute compressed air in pipes that end in the cylinder chambers, to actuators pneumatic (cylinders, vacuum generators, vane motors…etc.) from a signal ordered. [6]



Figure.I.6. Pneumatic distributor

I.5.4.2. Actuator

I.5.4.2.1. Asynchronous motors

Asynchronous motor has a passive motor that is short-circuited permanently (squirrel-cage rotor) or temporarily (see slip ring rotor). It can produce up to several megawatts and is most frequently used as a standard three-phase motor in industrial application.

The magnetic field in the asynchronous motor is generate by a magnetizing current via the electrical energy provided. Asynchronous motor are characterize by slip. Load-dependentdifference between the rotor speed and the speed of the rotary field of the supply voltage [8]



Figure.I.7. Asynchronous motor

I.5.4.2.2. Hydraulic cylinder

A hydraulic cylinder is a mechanical actuator that used to give a unidirectional force through a unidirectional stroke. It has many applications, notably in construction equipment, manufacturing machinery, and civil engineering.

I.5.4.2.2.1. Single acting hydraulic cylinder

A single-acting cylinder in a reciprocating is a cylinder in which the working fluid acts on one side of the piston only. A single-acting cylinder relies on the load, springs, other cylinders, or the momentum of a flywheel, to push the piston back in the other direction.

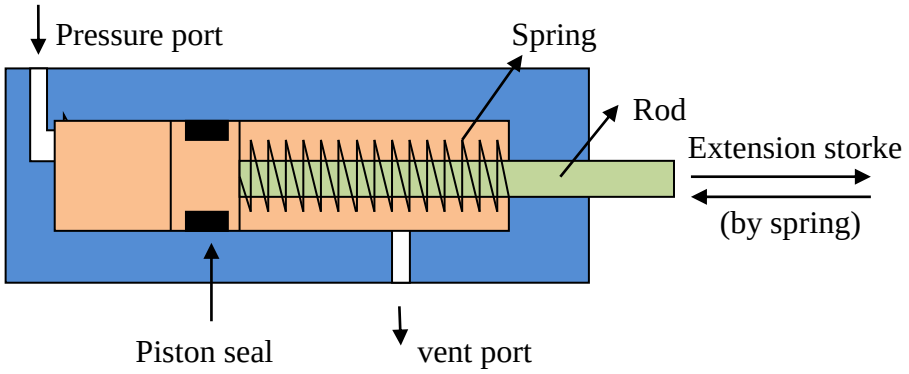


Figure.I.8. Single-acting cylinder schema

I.5.4.2.2.2. Double-acting hydraulic cylinder

A double-acting cylinder uses towlines and gives a full power of hydraulic system in both directions. If there is a need to press and lift with the same arm or another device, a double acting cylinder is ideal. This versatile option gives the power in two directions for a multi-use piece of equipment.

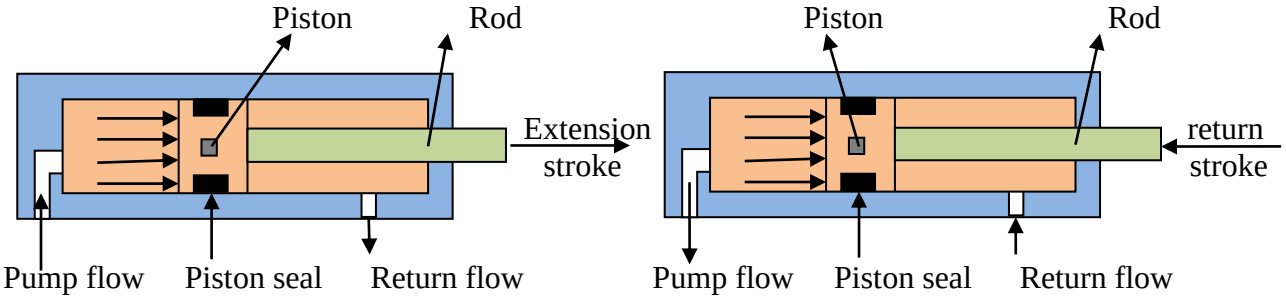


Figure.I.9. Double-acting cylinder schema

I.5.4.3. Circuit breaker

A circuit breaker is an automatically electrical switch designed to protect an electrical circuit from damage caused by excess current from an overload or short circuit. Its basic function isto interrupt current flow after a fault detected. Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation. [8]

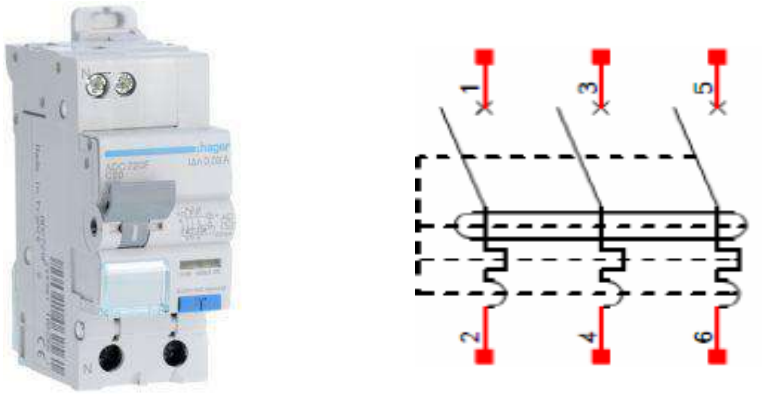


Figure.I.10. Differential circuit breaker bipolar and her symbol

I.5.4.4. Sensors

Sensors is an element of collecting and coding information on a process or on the system environment, It converts a physical quantity (position, speed…etc.) into an information called report.

I.5.4.4.1. Inductive sensors

Inductive sensors use the interaction of metallic object with their field electromagnetic. Eddy currents are created and cause decrease energy in the oscillating circuit, this has the consequence of reducing the amplitude of oscillation. The sensor detects this modification.

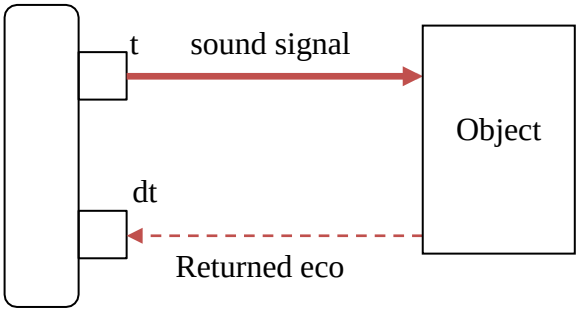


Figure.I.11. Inductive sensors

I.5.4.4.2. Photocell sensors

A photocell is a resistor that changes resistance depending on the amount of light incident on it. A photocell operates on semiconductor photoconductivity; the energy of photons hitting the semiconductor frees electrons to flow decreasing the resistance.

- As long as there is no part between the transmitter and the receiver receives the light beam.
- If there is a part, the beam is cut the receiver no longer receives the light of the transmitter.

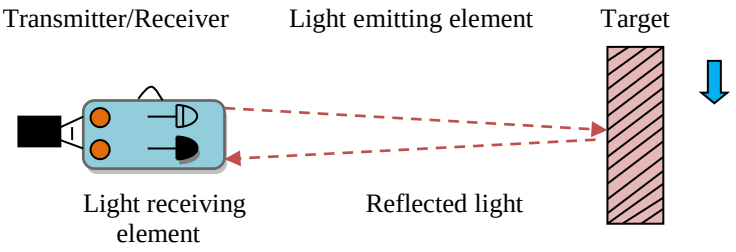


Figure.I.12. Photocell sensors

I.5.4.4.3. End of course sensors

It is a switch, controlled by the movement of a control member (test body). When the testbody is actuated, it opens or closes an electrical contact.



Figure.I.13. End of course sensors

I.5.4.5. Phase relay

The devices provide protection against phase loss, phase reversal, and phase unbalance due to blown fuses, broken wires or worn contacts. They monitor simultaneous voltage drops/increases and help to prevent damaged machinery and the injury of personnel.



Phase relays Asymmetric | Phase sequence relays | Symbol

Figure.I.14. Different types of relays

I.5.4.6. Thermal relay

A thermal overload relay works on the heat produced by the overload current is utilized to trip the motor circuit. These are mostly used for protection of low-voltage squirrel cage induction motors or DC motors of lower output rating. Used in motor starter circuits is to prevent the motor from drawing excessive currents, which is harmful to motor insulation. [8]



Electronic thermal relay | Three-pool thermal relay | Symbol

Figure.I.15. Different types of thermal relay

I.5.5.The relation or dialogue part (HMI)

Represents the exchange of information between the control part and the operator (pilot, use, supervisor, etc...) from which it receives instructions and to whom it provides reports visual or sound.

I.6.General information on programmable logic controllers

I.6.1.Definition

A programmable logic controller (PLC) is an industrial computer control system that continuously monitors the state of input devices and makes decisions based upon a custom program to control the state of output devices.

I.6.2.The advantages and disadvantages

The advantages are

- Improve working conditions by eliminating repetitive work.
- Improve productivity by increasing production.
- Improve product quality or reducing production costs.
- Simplification of wiring.
- Increase security.
- Power and speed.
- Ease of maintenance (the PLC by itself is relatively reliable and can help man in his search for faults).
- Programmable logic controllers are easy to program and have a language of easy to understand programming (programmed logic) then the modification of the easy program compared to hard-wired logic.
- Huge possibility of exploitation.
- Communication possibilities with the world (computer, other PLC).

The disadvantages are

- There is too much work required on the connecting wires.
- Need training.

I.6.3. PLC architecture

I.6.3.1. External aspect

The controllers can be of compact or modular type

- **Compact type** a distinction made between programming modules (LOGO by Siemens, ZELIO by Schneider, MILLENIUM by Crozet, etc.) are micro PLCs. He integrates processor, power, inputs and outputs. Depending on the models and manufactures, it can perform certain additional function (fast counting, I/O analog, etc.)and receive limited number of extensions. [9]
- **Modular type** there is the processor, power supply and inputs interfaces/outputs reside in separate units (modules) and are fixing on one more racks containing the "backplane" (bus plus connectors). These automata are integrating in complex automation systems or power, processing capacity and flexibility need. [9]



Figure.I.16. Compact controller (Allen-Bradly)

I.6.3.2. Internal structure

Compact or modular in shape, the fundamental sub-assemblies making up a programmable logiccontroller are

- The central unit or CPU, which processes the variables according to the logic processing, programmed into memory and prepare control orders.
- The tank head, which provides the link between the central unit and the interfaces.
- Input interfaces that receive machine data from sensors. [7]

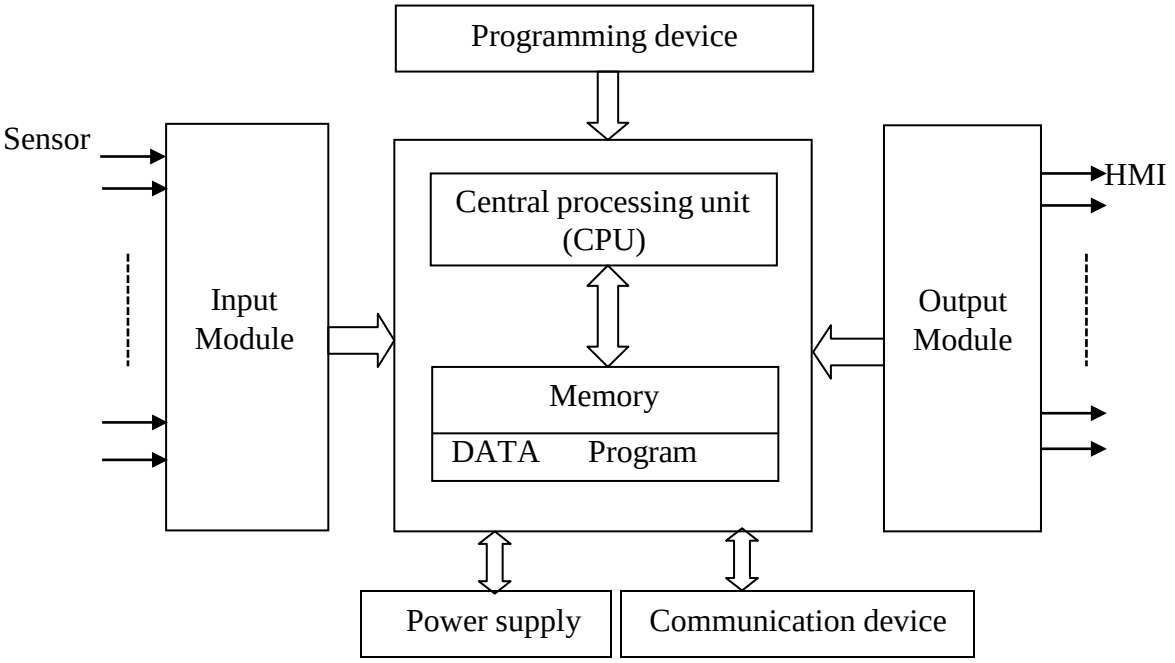


Figure.I.17. Internal structure of a PLC

I.6.3.3. The PLC central unit (CPU)

The central unit is the heart of the automaton, and functionally consists of the elements following:

I.6.3.3.1. Processing unit

The processor called the processing unit or arithmetic and logic unit, has a dual role of ensuring the control of the entire machine and performing the processing requested by the instructions of a program.

Connected to memories and I/O interfaces by parallel bus type links, the processor contains registers, which are memories, associated with logic circuits of so as to enable the performance of certain processing and service functions.[7]

I.6.3.3.2. Central memory

Memory is the functional element that can receive, store and restore information. An electronic device used to store information (from input or processor-generated sensors to control outputs).

We distinguish between the possibilities or not of writing and erasing or reading the different types of memory that can be finding in a PLC. [7]

I.6.3.4. Link bus

Electronic cards called couplers provide the interfaces between the process and the internal logic of a PLC. The bus is an information path between the cards and with the outside world. It is a printed circuit located at the bottom of the case to which the processor is connected, the main memory and couplers. [7]

I.6.3.5. Input/output system (I/O)

Conventional I/O devices allow the connection of processes located at low remote from the PLC, some PLCs even allow the module to be remotely offset I/O from 100 to 300 m and operate in synchronous mode, and transmission by modem allows decentralization of I/O system. [7]

I.6.3.5.1. Input interface

Input interface unit is a type of interface unit, which use in computer system to convert analog signals into digital signals, it converts the user signals into signals used by the computer system and it converts computational signals used by the computer system into the user signals. [5]

I.6.3.5.2. Output interface

Input output interface provides a method for transferring information between internal storage and external I/O devices. Peripherals connected to a computer need special communication links for interfacing them with the central processing unit. [5]

1.6.3.6. Programmable controller peripherals

I.6.3.6.1. Programming console

The programming console provides access to the memory of the PLC; his role is to translate user instructions from mnemonic code into executable machine instruction by the automaton. [7]

I.6.3.6.2. Test box

A test box allows

- The visualization of all inputs, outputs or internal memories.
- Viewing the instruction, operating code and address of the operand.

- Manual display of the program line to be controlled.
- Viewing the content of the logic accumulator, after execution of the instruction this allows, step by step, to locate the place where the equation ceases to be satisfied and therefore to determine the origin of a possible failure. [7]

I.6.3.6.3. Online dialogue unit

The online dialogue unit offers additional possibilities to the test box for occasionalinterventions:

- Constant modification.
- Access to current parameter values.
- Monitoring and adjustment of timers and counters.
- Load production program. [7]

I.6.3.6.4. Parallel printer

It is possible to edit certain results on the printer (counters, time delays, weight, andvarious measures) or error messages. [7]

I.6.4. Types of industrial programmable logic controllers

I.6.4.1. Small range automatons

These PLCs are intending for small application. The number of inputs and output does not exceed 48. They come in compact boxes or all modules (CPU, Power supply, I/O module, communication interface) are integrating in a memory case. It has no possibility of extension.

I.6.4.2.Mid-range machines

In this range, the number of I/O can reach 400; these PLCs have a structure modular expandable.

I.6.4.3.High-end PLCs

These PLCs are super powerful whose performance makes it possible to manage up to 2024 I/O and more. It has a modular structure.

I.6.5. PLC programming languages

I.6.5.1. LD contact language (Ladder Diagram)

Ladder Diagram, better known as ladder logic, is a programming language used to program PLCs. Contacts are placed in series to represent AND logic and in parallel when using OR logic. As with real relays, there are normally open contacts and normally closed contacts. [5]

I.6.5.2. FBD language (Function Block Diagram)

The Function Block Diagram (FBD) is a graphical language for programmable logic controller design that can describe the function between input variables and output variables.

A function is describing as a set of elementary blocks. Inputs and outputs of the blocks are wiring together with connection lines, or links. [5]

I.6.5.3. IL language (List statement)

Instruction lists (or ILs) are one of the five PLC programming languages defined by the IEC 61131-3 standard. Instead, they most resemble assembly language programming. As the name implies, a program is a series of instruction, listed in much the same way as an assembly program. [5]

I.6.5.4. Structured Text (ST) literal language

Structured Text is PLC programming language defined by PLCOPEN in IEC 61131-3. The programming language is text-based, compared to the graphics-based ladder diagram or Function Block Diagram. You can even have function blocks containing function written in structured text. [5]

I.6.5.5. GRAFCET language

Sequential function chart (SFC) is a graphical programming language used for programmable logic controllers (PLCs). The SFC standard defines as, preparation of function charts for control systems, and it based on GRAFCET (itself based on binary Petri nets). [5]

I.6.6. Criteria for choosing a programmable logic controller

In order to choose the PLC we to must identify the need, which is

- **Number of inputs / outputs** the number of cards may affect the number of racks assoon as the number of inputs / outputs required becomes high.

- **Processor type** memory size, processing speed and functions special offers offered by the processor will allow the choice in the range often very extent.
- **Functions or modules Special** certain cards (axis control, weighing ...) will relieve the processor and must offer the desired characteristics.
- **Communication functions** the controller must be able to communicate with others control systems (PLC, supervision, etc.) and offer possibilities for communications with standardized standards. [10]

I.6.7. Main API builders

The main API builders are German, American, French, Japanese and Swedish. For examples: SCHNEIDER, SIEMENS, ABB, ALLEN BRADLEY, BOSH-REXROTH, FESTO, GEFANUC, HONEWELL, VIPA, OMRON, -ELECTRIC, MITSHUBISHI.

I.7. Conclusion

The complexity of systems in industries (electronic cards require time to deal with any problem and a specialist) prompts managers to seek an automation solution for a better control of systems, we must use automation in an efficient manner this ensuring optimal control of the production, with a good understanding of how the system works.

In this chapter, we have mentioned some concepts related to automation systems to be identified and described in the next chapter of our system for elaborate mechanism.

Chapter II

CAM HF77 machine operating

II.1. Introduction

We say a system is automated when the process passé from the initial situation to final situation without human need, which manages the energy supply and provides a better quality of products with security and flexibility of the processes.

In this chapter, we will see the system identification and his principle operating.

II.2. History

CAM founded in 1949, it was the first Italian designer of automatic machines for carton packaging.

With over 60 years of experience, CAM is able to supply complete lines of machines with feeding unites suitable to handle all types of products, whether liquid or solid powder or crème also in many industrial sectors including the pharmaceutical, cosmetic and food industry.

The CAM trade mark represents a structure involving 15 manufacturing companies, 17 trade centerswith agents scattered in 27 countries and 14 after sales center to provide technical assistance throughout the world. [11]



Figure.II.1. CAM Company LOGO

II.3. General description



Figure.II.2. CAM machine HF 77 [11]

The operator side of the HF is perfectly linear and accessible, allowing case loading to be carried-out with convenience and with large carton storage capacity. This feature also gives the operator full vision and total control of all the functions carried-out on the machine. The cantilever structure, separating the mechanical transmission from the product/case handling areas, guarantees total accessibility for machine inspection purposes and immediate elimination of product/packaging material residue, in compliance with GMP norms.

The exclusive case erection system incorporating a continuous motion 5-station turret, each station separately driven by closed-profile cams for carton pick-off at zero speed, allows for total and progressive carton pre-breaking to be carried-out in a time period longer than the machinecycle. Each case erection station is composed of two suction-cup arms which, by pulling externally on the two adjacent faces of the carton, guarantee positive opening, whatever board grammage is used and even in the case of handling square-section formats. The product transport buckets, moving following a cam profile are inserted into the cases,allowing perfect introduction even when handling products with irregular shape/dimensions. The possibility to adopt pusher upper blades with differentiated stroke enables perfect introduction of leaflets/booklets and other similar items into the case, independently from the characteristics ofthe product to be handled.

The wide range of product feeders available covers all possible packaging requirements of the Pharmaceutical, Cosmetic and Food Industries

CAM has recently developed and patented a new carton closure system, that grants the possibility of: carrying out format change without requiring the services of a specialized technician; eliminating fine tuning time related to the closure area; and absolute quality consistency of the final package.

As on all CAM machinery, the HV is also equipped with the Mechanical Memory system, transforming complete size change-over into a series of rapid and pre-set operations, which can be carried-out by unskilled personnel in less than 10 minutes, eliminating the need for fine-tuning adjustments and allowing size change-over to coincide with actual production change-over.

II.4. CAM HF77 dimensions

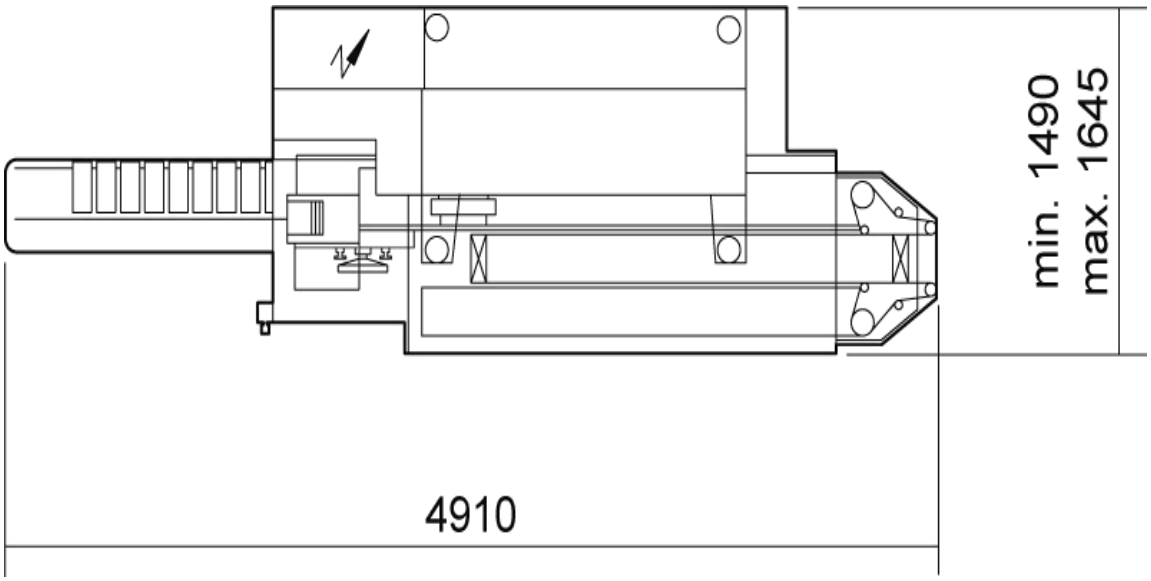


Figure.II.3. CAM HF 77 dimensions [11]

II.5. Technical characteristics and conditioning

II.5.1. Size of rang

	A	B	C	A+B
Min.mm	20	12	70	-
Max.mm	95	70	230	165

Table.II.1. Format of rang

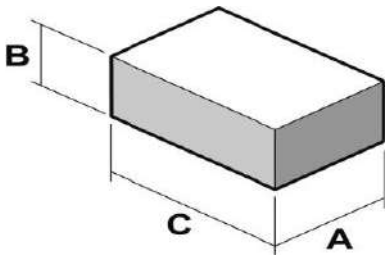


Figure.II.4. Size of rang

II.5.2. Technical data

Mechanical speed	STROKES/1’	Max.400
Motors	KW	4.25
Power absorption	KW	5.20 (hot-melt+3.9)
Air consumption	NI/1’	16.9
Air pressure	Bar	5+6
Gross weight	Kg	~3000
Net weight	Kg	~2500

Table.II.2. Technical data [11]

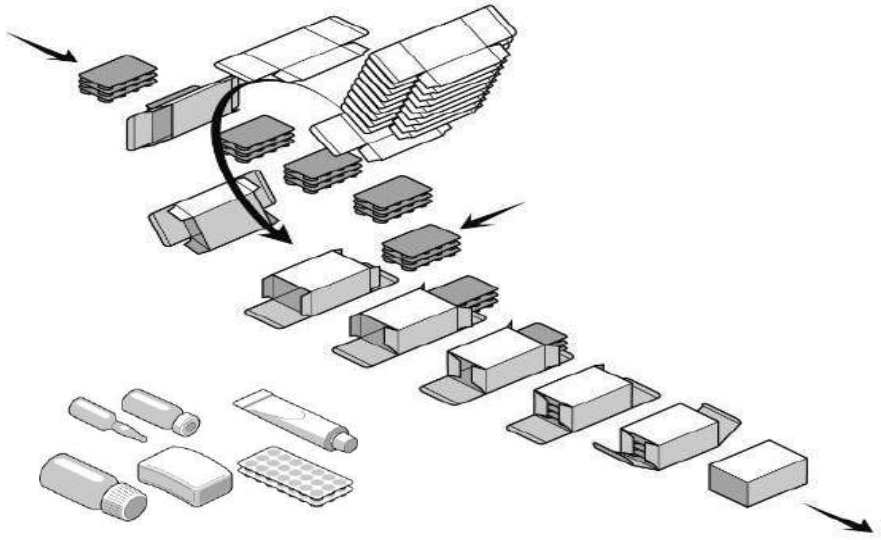


Figure.II.5. Machine working flow and different packed products [11]

II.6. Operational chain

Conditioned products are introduced in the cells of feed conveyor, there's a sensor placed on the conveyor which detect the presence of the product. At first the case in opened by suction cups and introduced in transport chain cases. A sensitive control the present in the cell of conveyor correspond the case in transport chain cases.

If the conditions is completes (on request) with leaflet. The sensitive control transmits cases also in the other side the leaflet are already folded (mechanic part). The leaflet has been taking by suction cup; it's introduced in belts series, directly if the leaflet is already folded or after folded in the pre-established way if the leaflet was flat. The leaflet is transported by belts clamp (we find it under the cells of machine feed chain).

All the elements that make up the conditioning advance to the introductory station where oussoire series put them into case (the product meet the instruction paper and introues it into the case).

After completing introduction operating, the packaging advances to the closure area, where a succession of folding operating complete the conditioning cycle.

A series of electric and mechanical safety control the entire operating cycle and stop the machine if there's any anomalies to avoid machine damage.

In order to avoid unnecessary stops which could reduce production, the machine can be equipped with expelling groups, in the presence of any anomalies expel any incomplete packaging without interrupting the conditioning cycle. [12]

II.7. Description of the machine functioning

HF 77 machine has four essentially parts which is

- Selection section.
- Leaflet and case section.
- Closing section.
- Ejection section.

II.7.1. Selection section

The ointment product comes two by two, to be thrower to the goudet one by one, and it alwayswork even the product is absent or present.

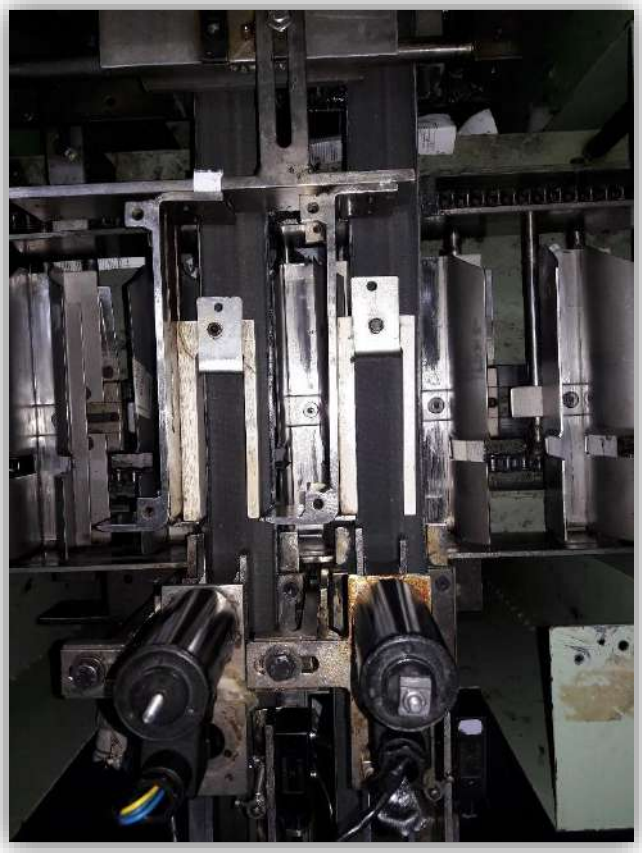


Figure.II.6. Selection section [13]

I.7.2. Leaflet and case section

When all the alarms are checked and the system get started, one the product is present after twostep, the leaflet will fall down then after three step it'll get into the case to contain the operation to the 3rd section, whether if there's less than 3 absence of product, the machine will contain the functioning until the 4rd section to be ejected, if there's 3 absence consecutive the motor will turn off, and the functioning stop.



Figure.II.7. Presence of product [13]



Figure.II.8. Putting the leaflet and the product into the case [13]

II.7.3.Closing section

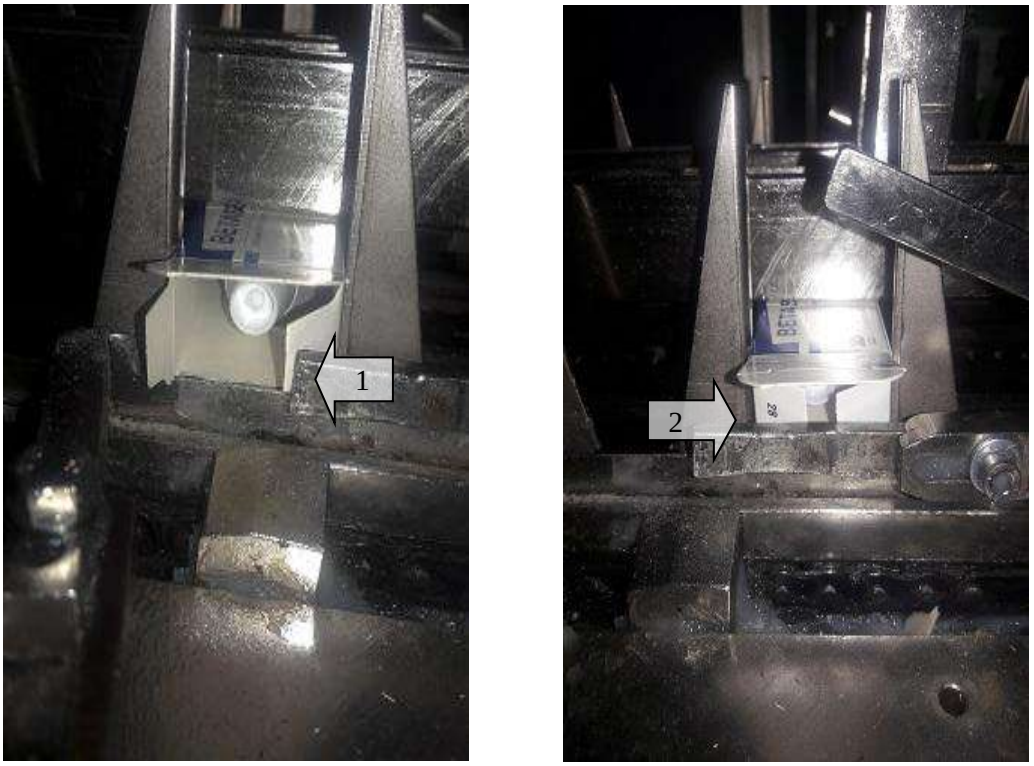


Figure.II.9. Closing the case from left of the case to right [13]



Figure.II.10. Closing from the front and behind of case [13]

II.7.4. Ejection section

If the product has no leaflet in the case, after 20 steps it'll be ejected, so the absence of less than three notice paper will not influence at the machine system at first, so the functioning will be contained and the system save a memory of the absence until the ejection.

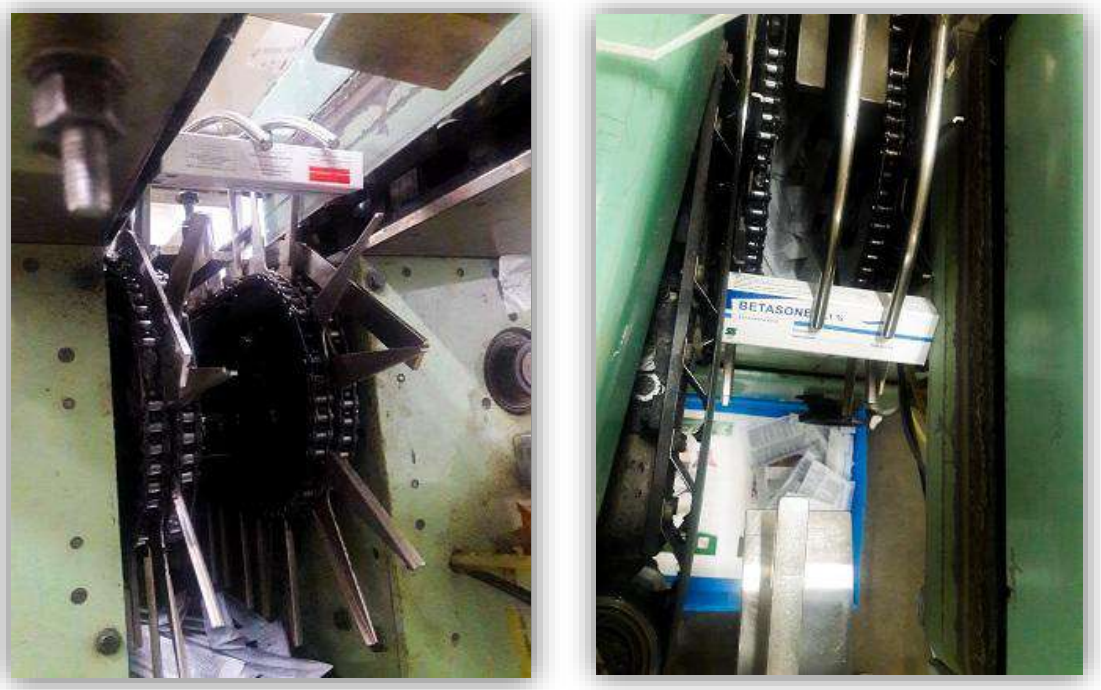


Figure.II.11. Ejection section from different angles [13]

II.8. Machine actuators

II.8.1. Three-phase motor

The main role of three-phase asynchronous motor is to do the system mechanism.



Figure.II.12. ISGEV ARZIGNANO three-phase motor

II.8.2. Vacuum pump

The role of the pump is to create the vacuum for the aspiration of leaflet and cases by suction cup



Figure.II.13. Vacuum pump

II.9. Sensors

The machine has several sensors in different area, which are inductive sensors and photocell sensors.

II.9.1. Inductive sensors

The machine contains these types of sensor, which detect the presence of the tube, and the otherfour sensors to detect the presence of the bucket.



Figure.II.14. Inductive sensors [13]

II.9.2. Photocell sensors

Photocell sensors use to detect the presence of the leaflet.

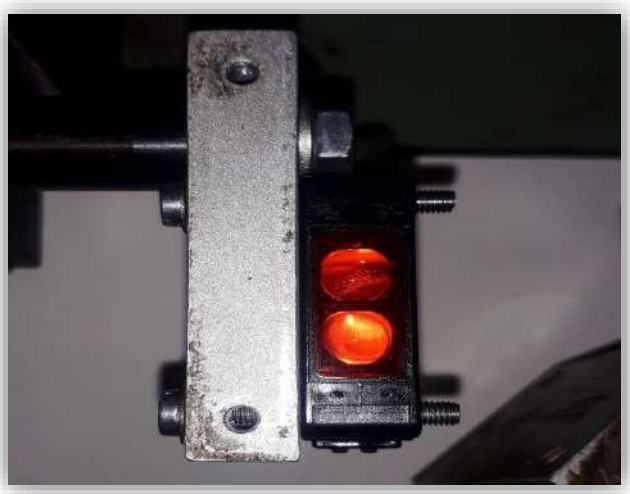


Figure.II.15. Photocell sensors [13]

II.10. Machine electrical cabinet

The electrical cabinet is a place where a different systems participating in the distribution of an electrical installation, the cabinet that contains the transformer, the circuit breakers, contactors, electronic cards, terminal blocks.

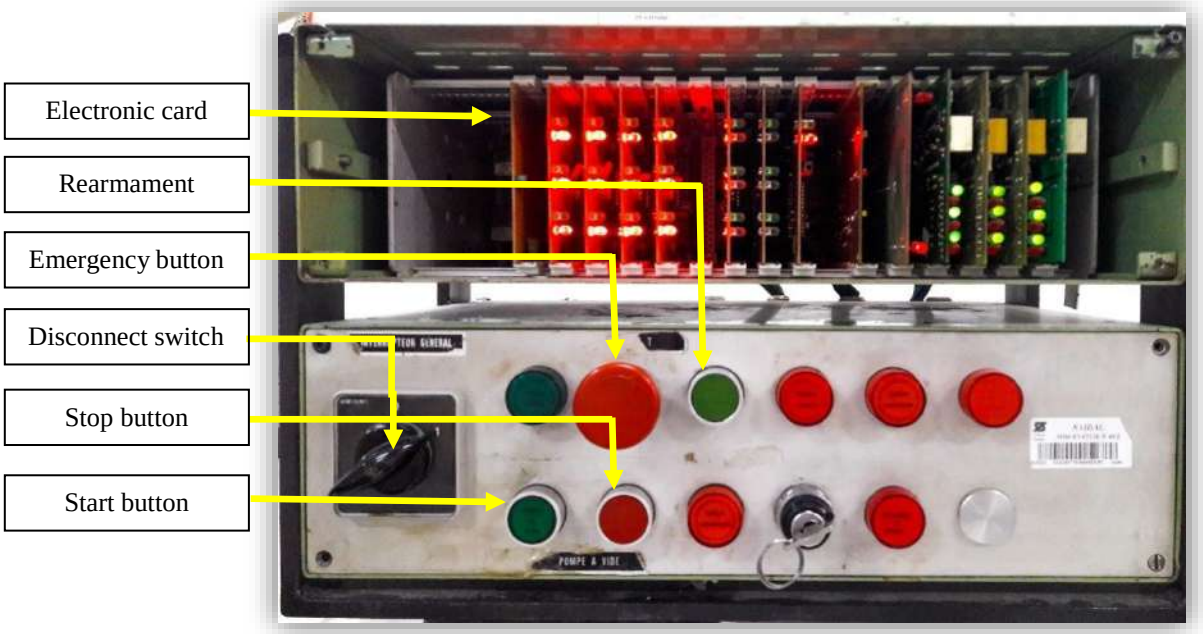


Figure.II.16. Electrical cabinet [13]

II.11. The electronic card

The machine controlled by an electronics cards, this last makes it possible to arithmetic operations. The electronics cards are used in industrial areas to control production line.

The card is a printed circuit, in general it's a plate to maintain and connect electrically a set of electronic components (the microprocessors, memory, input output components, the buses, and circuit to operate the assembly "decoding, buffers, interfaces…").

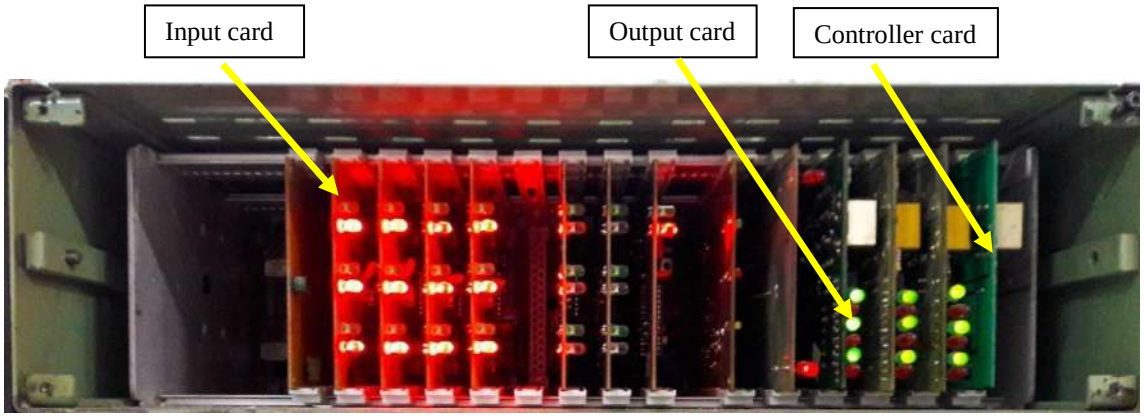


Figure.II.17. The electronic card [13]

II.11.1. Controller card

Controller card is an electronic device that consists of certain electronic components; it uses to process the exchange of data in the circuit of the card and allows the exchange of addresses with certain auxiliary cards.



Figure.II.18. Controller card [13]

II.11.2. Input / output cards

The input and output cards represent data objects. Each card represents one data object, defined as aparticular type. There are two types of map cards; input cards and output cards.

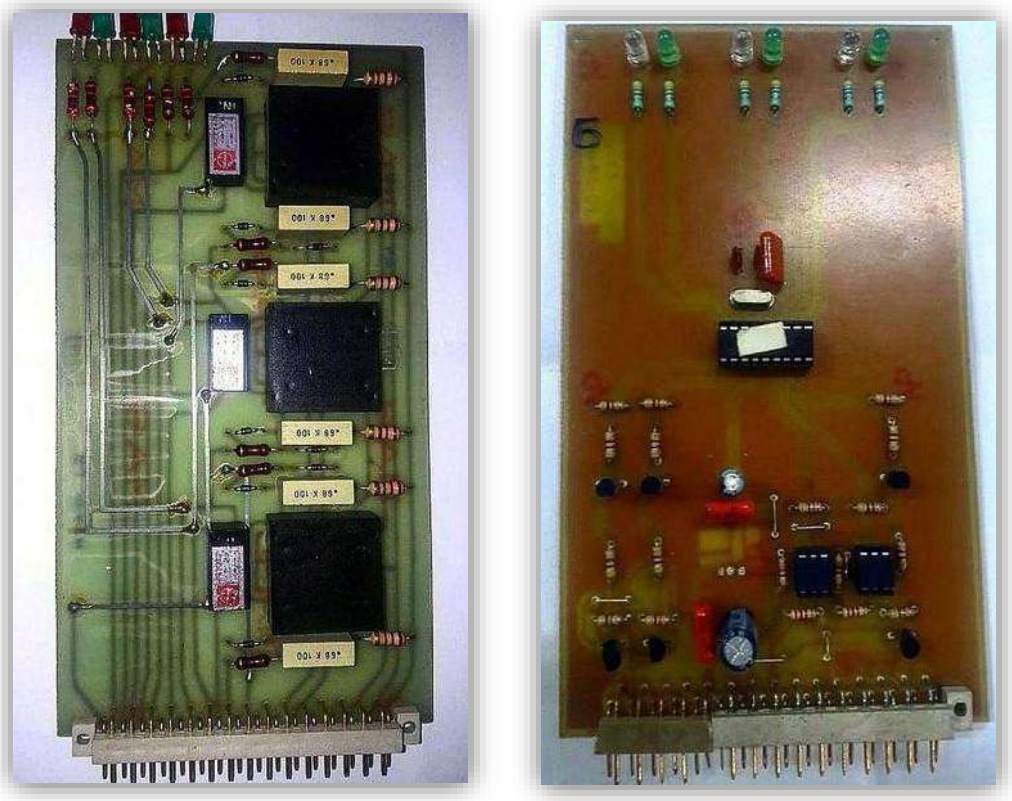


Figure.II.19. Input card and output card

III.11.3. Connexion bus

This organ is the objective to transmit the information to the Controller card and another complimentary card that placed superpose than another card.



Figure.II.20. Link [13]

II.12. The advantages and disadvantages of electronics cards

The advantages	The disadvantages
➢ Performs complex mathematical operations. ➢ Electronic card control provides great reliability and the best flexibility. ➢ Integration of all functions on one pillar. ➢ Speed in transferring data between different sites from memory. ➢ Industrial electronic cards offer multi-tasking functionality in real-time. ➢ The use of electronic cards must be adapted to control the system.	➢ The Electronic card components and spare parts difficult to find. ➢ The inability to modify the electronic card in the event of problems in the system. ➢ Data size limitation. ➢ Abnormal system functions in the event the card is heated. ➢ Use many sensors for the same activity. ➢ Card electronic can't memorize a step or action.

Table.II.3. The advantages and disadvantages of electronics cards

II.13. Conclusion

In this chapter, we had made the identification of the machine with a detail description of all the elements that make up the machine and we also talk about its functioning.

This chapter must be taken as an essential part for the chapter following, which complementary to this chapter the step of modernization of the machine through replacing electronics cards by a PLC.

Chapter III

Programming and simulation

III.1. Introduction

From the previous chapter, we are going to create a functioning for programming our system; we will remove the electronic card and replace them by an API.

So in this chapter we will present the PLC ZELIO by using the ZELIO SOFT2 interface of Schneider and explain the deferent steps of programming.

III.2. Functioning

Goal of automation

At first the machine was piloted by an electronics card which has so many disadvantages as we see before so that why we have to replace them by an API; the goal of this modification is:

- Ameliorate the machine operation.
- Increase their yield
- Minimize the breakdowns.
- Make the diagnosis of any breakdowns more easier

III.3. Raw materials

The system passé by three principal steps:

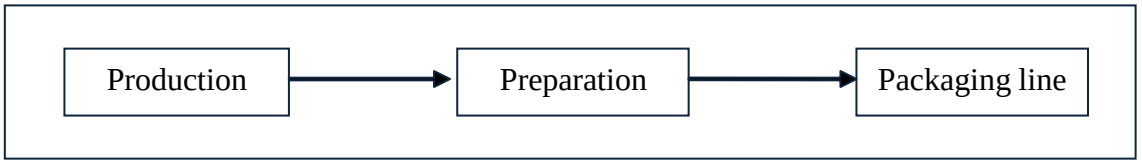


Figure.III.1. Principal steps of industry production

The packaging line is the last step of production in the industry and in our system passé by

- Presence of the ointment product.
- Presence of the notice paper.
- Put the notice paper and the ointment product on the etui
- Close the case.

III.4. Security

According to international safety standards

III.5. Functioning description

Etui machine is powered by an electrical power (w), the machine fills up ointment product and notice paper in an etui to close on them, at first two ointment product come as an initial state then the notice paper are already wrap up (mechanic part) one by one with air pressure, after both of the ointment and notice paper are putted in the case to be close on it also oneby one.

III.6. Presentation of ZELIO module

ZELIO API is a programmable module. It's allowed to control and set actuator depends on sensors state, time evolution and the program using. After studying and searching, we choose to work with ZELIO Soft2 software.

The PLC that we choose concentrate of functions whose most simplest to the most advancedfor all the installations. It's graphical software where the programming is by block functions that are proposed by ZELIO Soft2 with small icons and virtual wiring.

The choice was for SR3B360BD PLC. Who has 16 inputs and 10 outputs; the choice of programming language proposed with icon of software. So we got to choose between LADDER mode or function block diagram "FBD". [11]

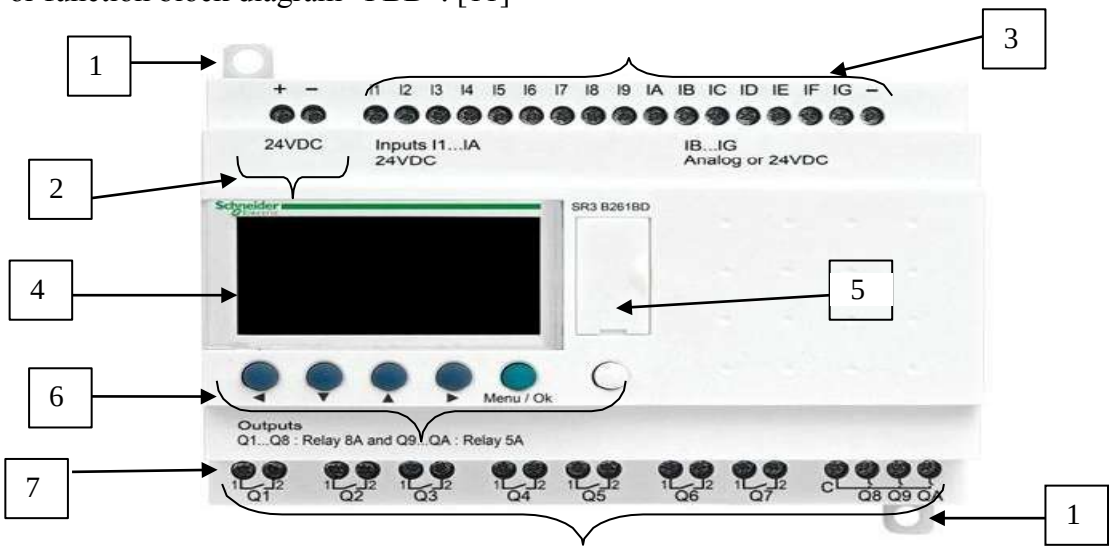


Figure.III.2. ZELIO SR3B261BD module

ZELIO logic modular smart relay front panels comprise

(1) Two retractable mounting feet.

(2) Two power supply terminals.

(3) Terminals for connecting the input.

(4) Backlit LCD display with four lines of 18 characters

(5) Slot for memory cartridge or connection to PC, modem communication interface HMI terminal, or Bluetooth interface.

(6) 6 buttons for programming and parameter entry

(7) Terminals for connecting the outputs.

III.7. Cabled and wireless programming tools

These programming tools allow the ZELIO logic smart relay to be connected to a PC running "ZELIO Soft2" software.

- Cable connection: SR2USB01 cable to USB port.



Figure.III.3. SR2USB01 cable

- Wireless link: SR2BTC01 Bluetooth interface.



Figure.III.4. SR2BTC01 Wireless

III.8. Purpose of choosing ZELIO PLC

We propose to remove the electronics cards and replace them by ZELIO PLC

- To avoid the breakdowns.
- To develop machine functioning.
- To avoid maintenance difficulty.
- To improve lifetime of the machine.
- To reduce the economic and personal cost.
- Allows material and energy saving.
- Increases personal safety.
- Controls and protects the machines and the installations.

III.9. Presentation of ZELIO Soft2 software

ZELIO Soft 2 programming software is designed to program the ZELIO logic smart relay family of controllers. ZELIO soft 2 allows to choosing between programming languages, display program and parameter data, upload and download application, and print application documentation. [15]

Figure.III.5. ZELIO Soft 2 logo

III.9.1. Details of ZELIO Soft2 software

- Programming can be by LADDER language or function blocks diagram (FBD).
- Possibility of programming 4 text blocks with texts and values that can be displayed onthe front panel.
- Surveillance of the application.
- A consistency test symbolized by an icon to check the viability at any time.
- Testing the application with or without using the module.
- Loading and unloading the programs.

- Edit personalize files.

- Online help.

III.9.2. Technical characteristics

We're going to see technical characteristics of ZELIO Soft2 software

To be used with	ZELIO Soft2
Versio n	4.6.0
Operation system	Windows 7, Windows 8, Windows 8.1, Windows 10,
Included instruction	CD
Languages available	Multi language

Table.III.1. Technical characteristics

III.10. Electrical scheme

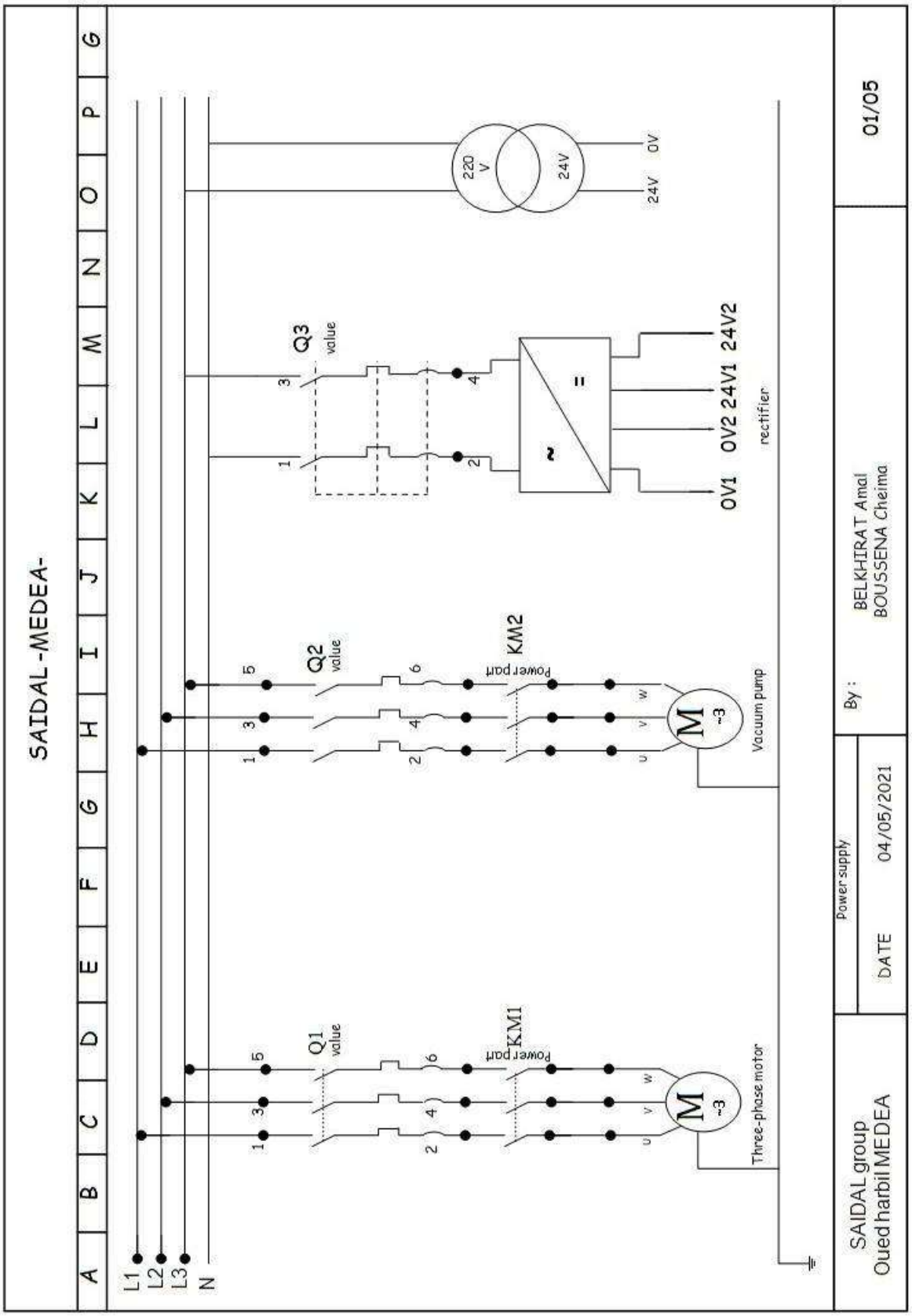
Generally, the electrical scheme includes alphanumeric identification, which is very useful for find different disseminated contacts. The electrical scheme contains two parts:

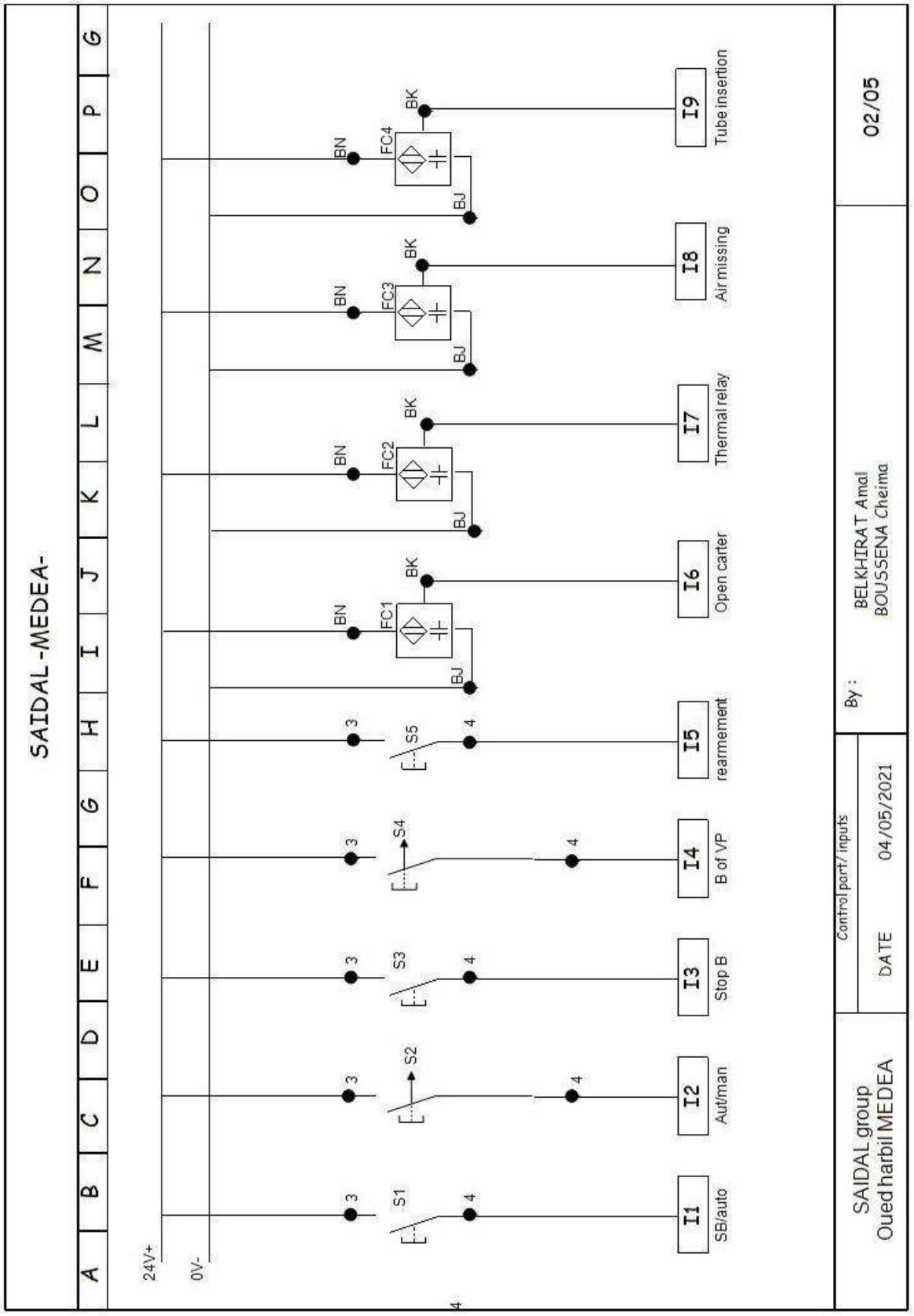
III.10.1. Power part

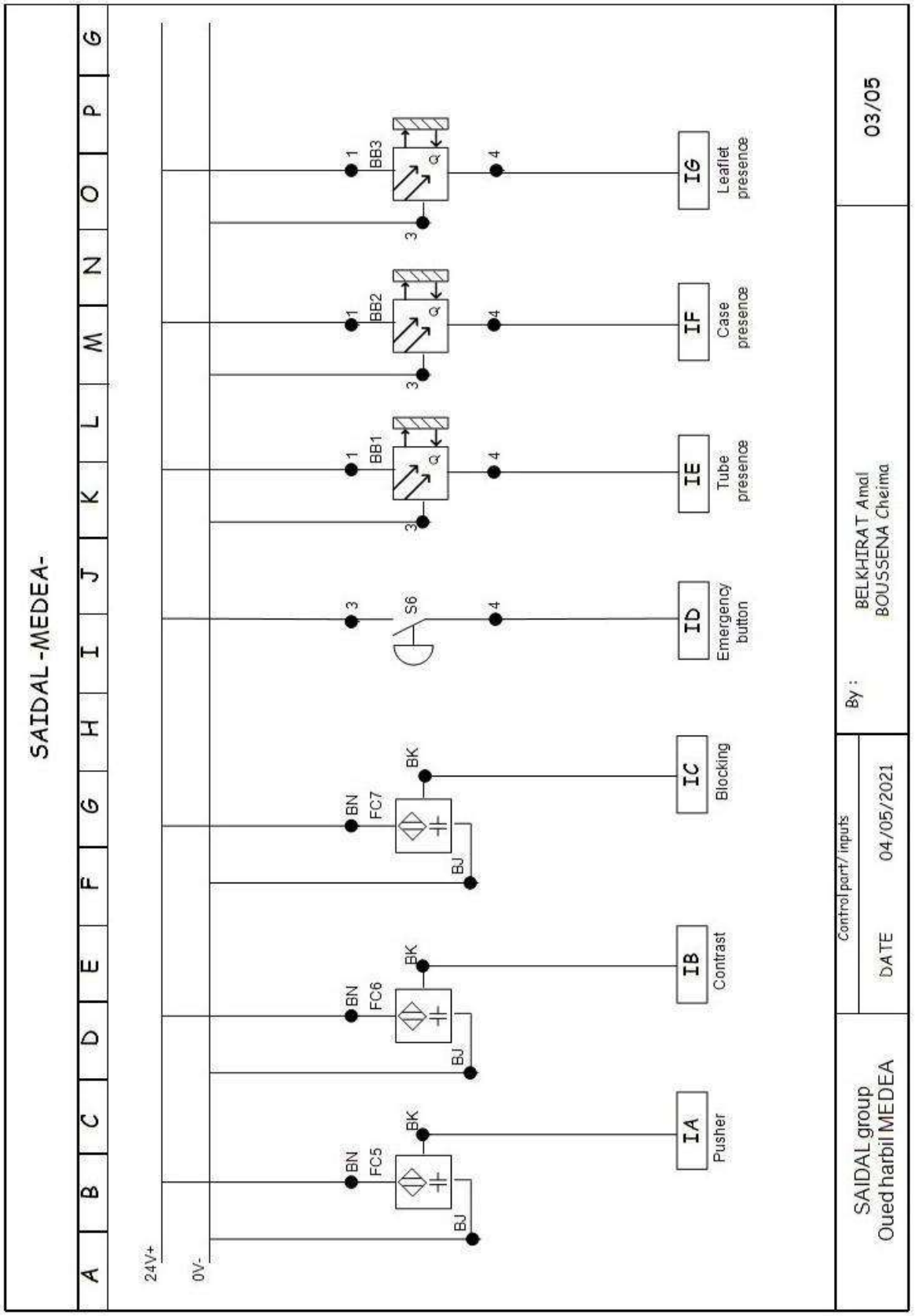
It's a developed diagram showing the part of wiring which controls the energizing the installation of different actuators.

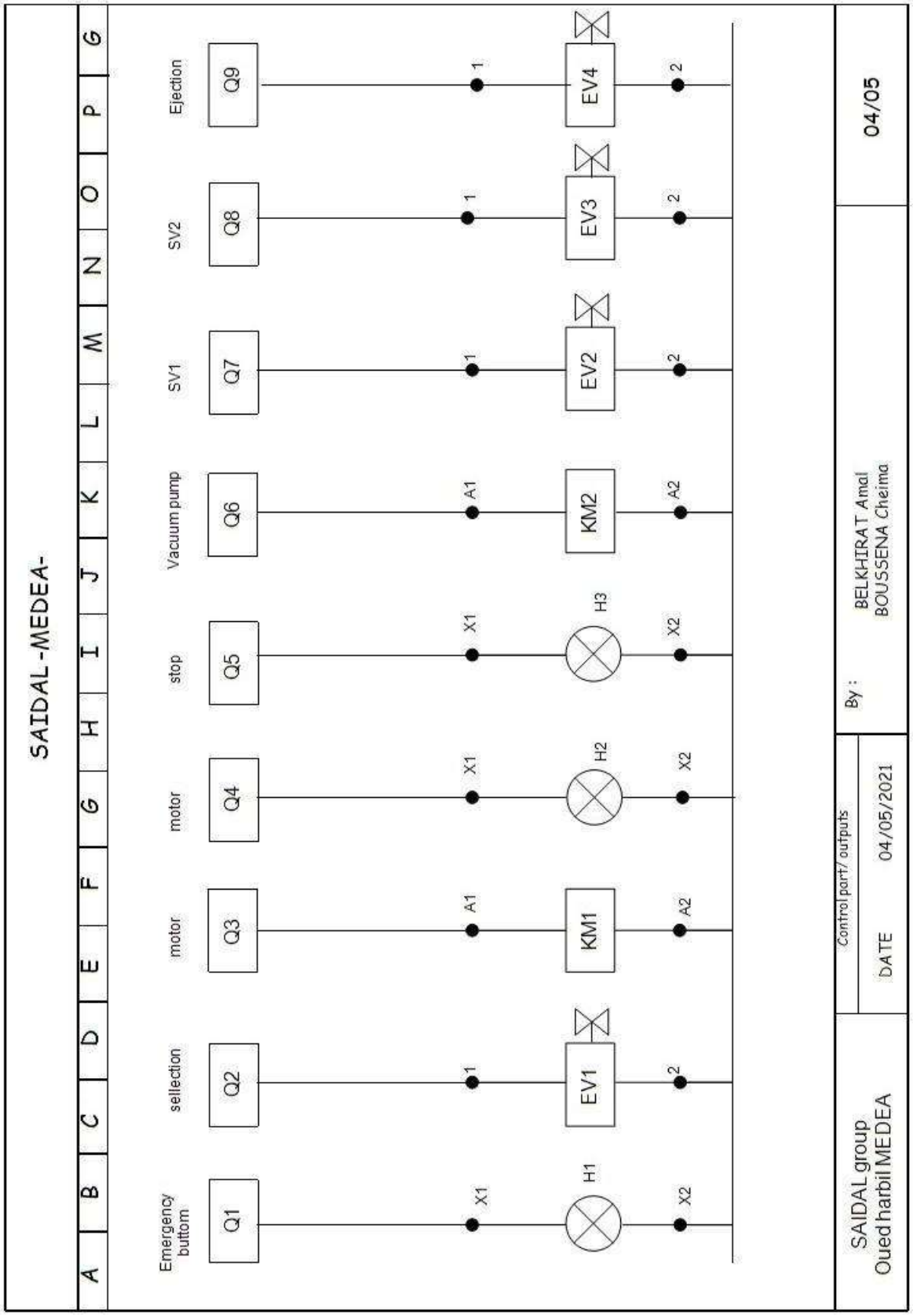
III.10.2. The control part

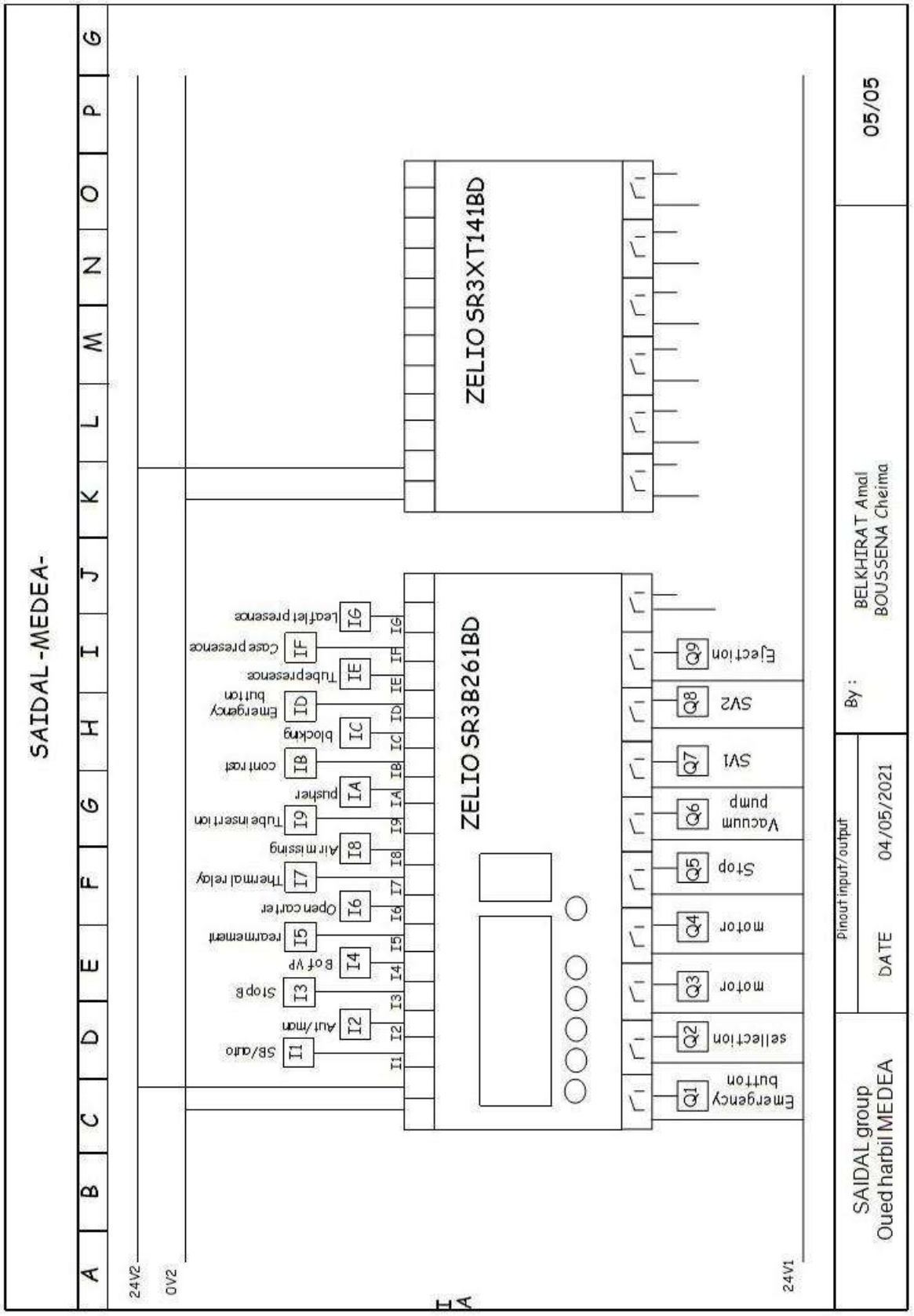
It's a developed diagram that represented the wiring part which fixed the operating mode of the machine. And the coordinates of each contact are specified under the contactor which belongs.


SAIDAL -MEDEA-
A B C D E F G H I J K L M N O P G
L1
L2
L3
N
220 V
24V
0V
24V
Q3
value
OV1 OV2 24V1 24V2
rectifier
Q2
value
KM2
Power part
Vacuum pump
Q1
value
KM1
Power part
Three-phase motor
M
~3
Power supply
DATE
04/05/2021
By :
BELKHIRAT Amal
BOUSSENA Cheima
SAIDAL group
Oued harbil MEDEA
01/05


SAIDAL -MEDEA-
A B C D E F G H I J K L M N O P G
24V+
0V-
S1
S2
S3
S4
S5
FC1
FC2
FC3
FC4
BN
BK
BJ
I1 SB/auto
I2 Aut/man
I3 Stop B
I4 B of VP
I5 rearmement
I6 Open carter
I7 Thermal relay
I8 Air missing
I9 Tube insertion
SAIDAL group
Oued harbil MEDEA
Control part/ inputs
DATE 04/05/2021
By : BELKHIRAT Amal
BOUSSENA Cheima
02/05


SAIDAL-MEDEA-
A B C D E F G H I J K L M N O P Q
24V+
0V-
BB3
BB2
BB1
S6
FC7
FC6
FC5
BN
BK
BJ
IG Leaflet presence
IF Case presence
IE Tube presence
ID Emergency button
IC Blocking
IB Contrast
IA Pusher
Control part/ inputs
DATE 04/05/2021
By : BELKHIRAT Amal
BOUSSENA Cheima
03/05
SAIDAL group
Oued harbil MEDEA


SAIDAL -MEDEA-
A B C D E F G H I J K L M N O P G
Emergency buttom
sellection
motor
motor
stop
Vacuum pump
SV1
SV2
Ejection
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
H1
EV1
KM1
H2
H3
KM2
EV2
EV3
EV4
X1
X2
A1
A2
1
2
SAIDAL group
Oued harbil MEDEA
Control part/ outputs
DATE 04/05/2021
By : BELKHIRAT Amal
BOUSSENA Cheima
04/05


SAIDAL -MEDEA-
A B C D E F G H I J K L M N O P G
24V2
0V2
ZELIO SR3XT141BD
ZELIO SR3B261BD
I1 SB/auto
I2 Aut/man
I3 Stop B
I4 B of VP
I5 rearmement
I6 Open cart'er
I7 Thermal relay
I8 Air missing
I9 Tube insertion
IA pusher
IB contract
IC blocking
ID Emergency button
IE Tube presence
IF Case presence
IG Leaflet presence
Q1 Emergency button
Q2 selection
Q3 motor
Q4 motor
Q5 Stop
Q6 Vacuum pump
Q7 SV1
Q8 SV2
Q9 Ejection
24V1
SAIDAL group
Oued harbil MEDEA
Pinout input/output
DATE 04/05/2021
By : BELKHIRAT Amal
BOUSSENA Cheima
05/05

III.11. Programming the ZELIO PLC «SR3B261BD»

III.11.1. Programming with GRAFCET SFC «Sequential function chart»

The GRAFCET «functional graph of control step transition» or SFC «sequential function chart» is a formal model being used to specify and also to control reactive systems of the type "all or nothing" (Boolean inputs and outputs). An automated system of production breaks up into two parts: The control part and the operative part; the operative part includes the process having to be controlled as well as the operator. The control part intended to process the data coming from the operative part to control it. [17]

The following figure shows an example of GRAFCET

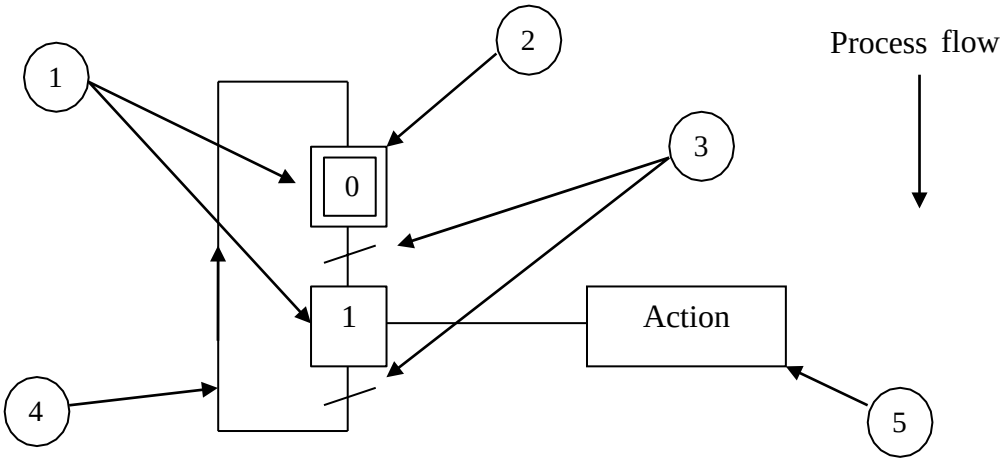


Figure.III.6. GRAFCET structure

(1) Steps

(2) Initial step

(3)Transitions

(4)Directed connections

(5)Action associated to step 1

III.12. Discover ZELIO Soft 2

III.12.1. Starting the program

When the ZELIO soft program is launched, the following window appears

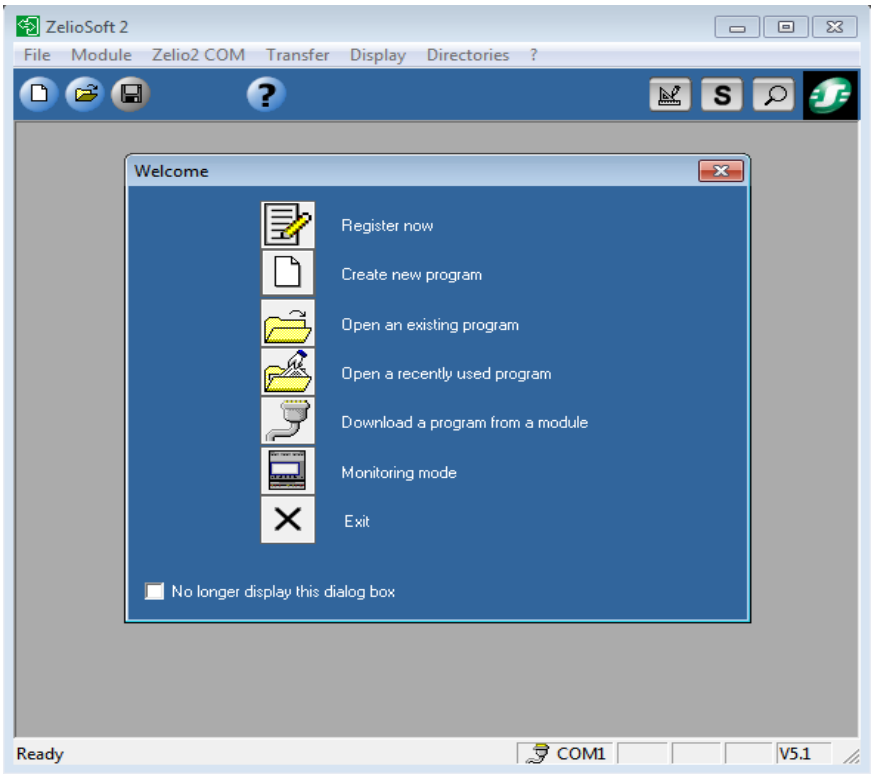
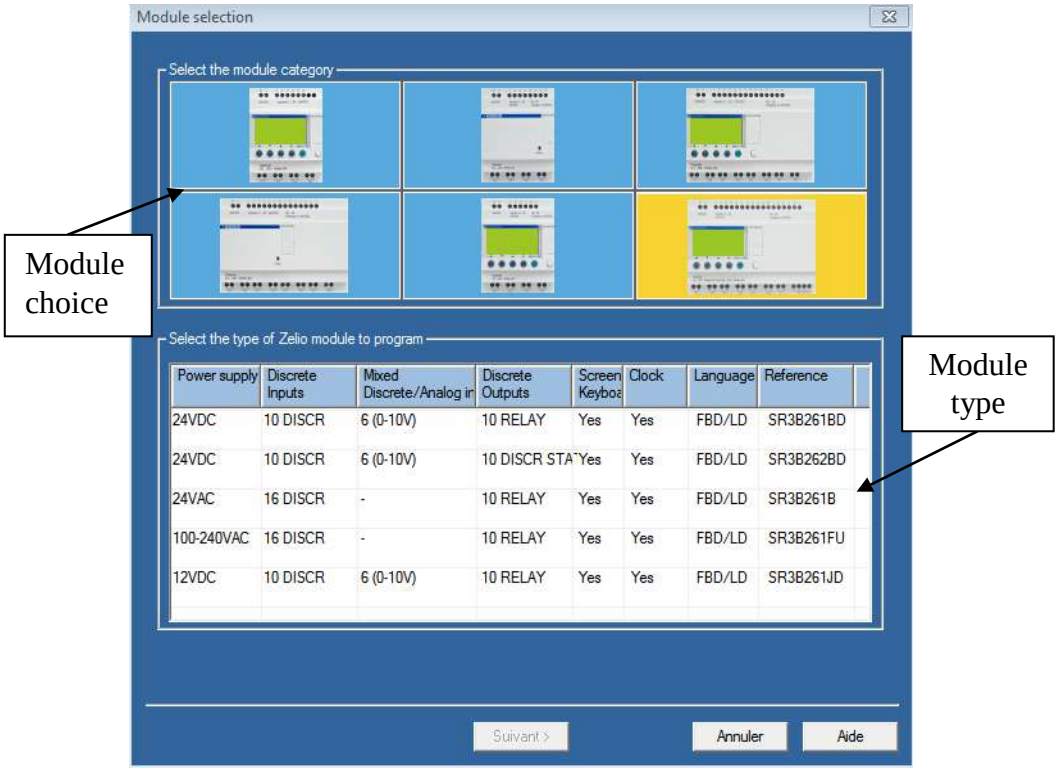


Figure.III.7. Welcome window

Click on create new program to start or choose new in the file menu if the program has Already been launched, the smart relay option window now appears



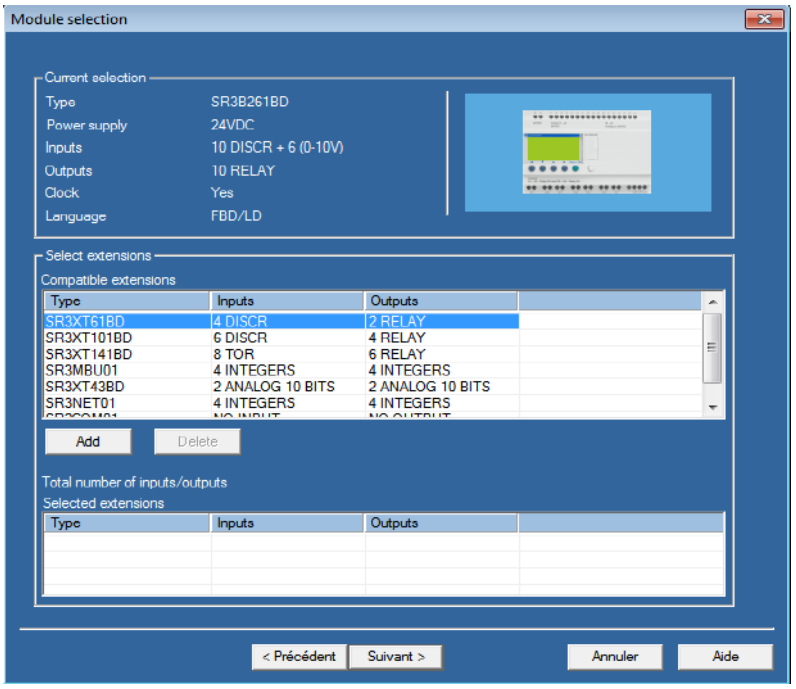


Figure.III.9. Module selection

III.12.2. Programming type

Ladder language is selected by default at the first opening (by default it'll select on yellow outline); if it's the chosen then we click on Next to program in Ladder. Else if we chose FBD so we click on the FBD icon then on Next to program in FBD.

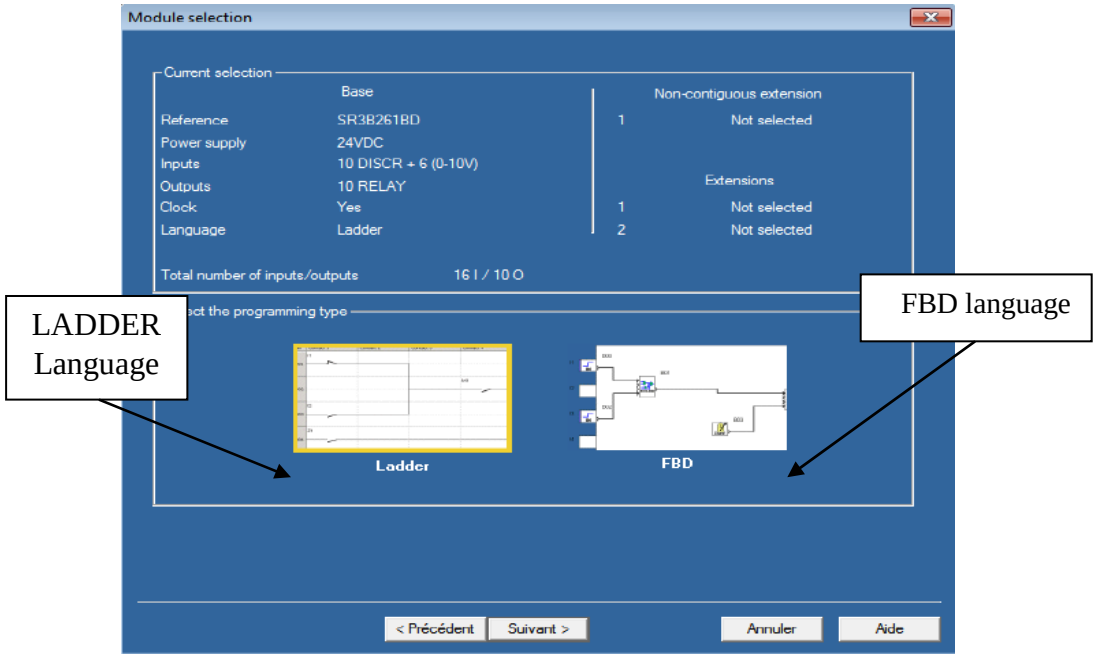


Figure.III.10. LADDER language

III.12.2.1. LADDER language

ZELIO Logic is programmable in Ladder language. This type of programming allowscarrying out combinational logic functions. In this way programming the applications with ZELIO Soft 2 or from its integrated programming screen and keyboard

In the next figure there are some inputs and outputs in LADDER language

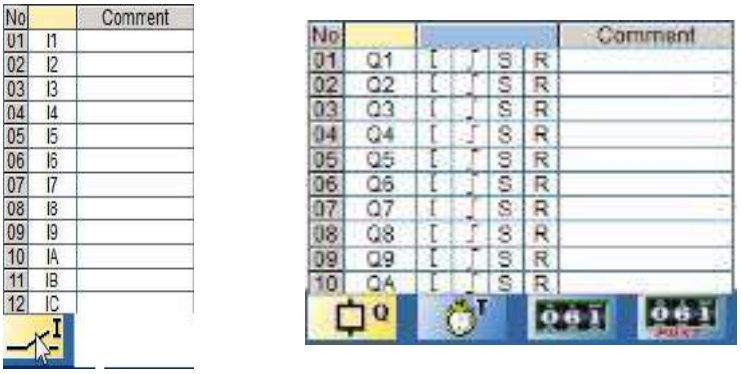


Figure.III.11. Functions with many types of inputs/outputs

III.12.2.2. Function block diagram

ZELIO logic may also program in FBD (Function Block Diagram) language, a graphic languageoffering multiple possibilities. We can add SFC-GRAFCET functions to the application.

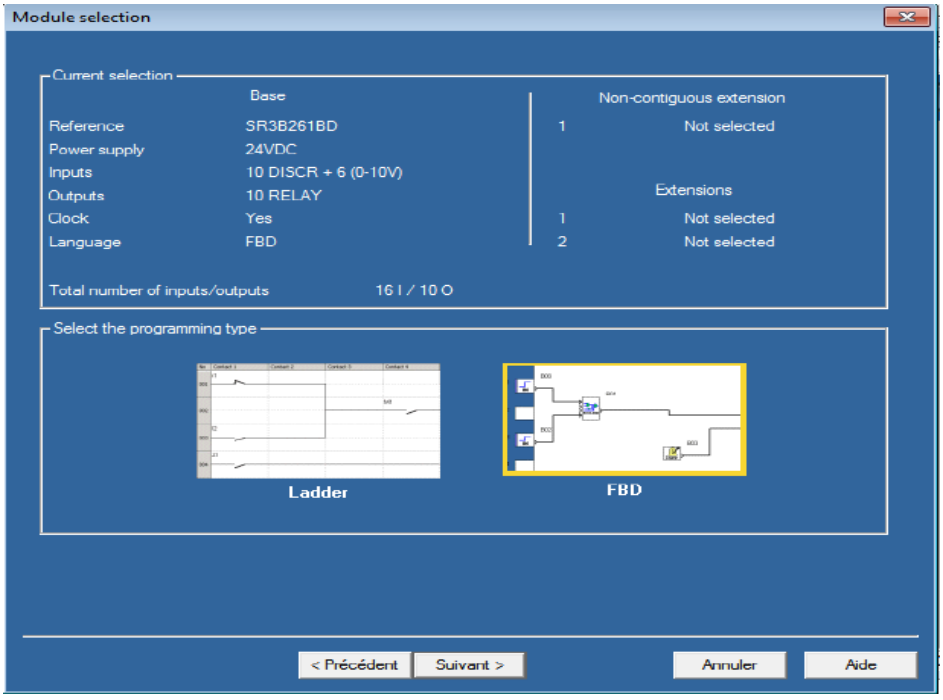


Figure.III.12. FBD language

When the FBD has been selected, a wiring sheet appears

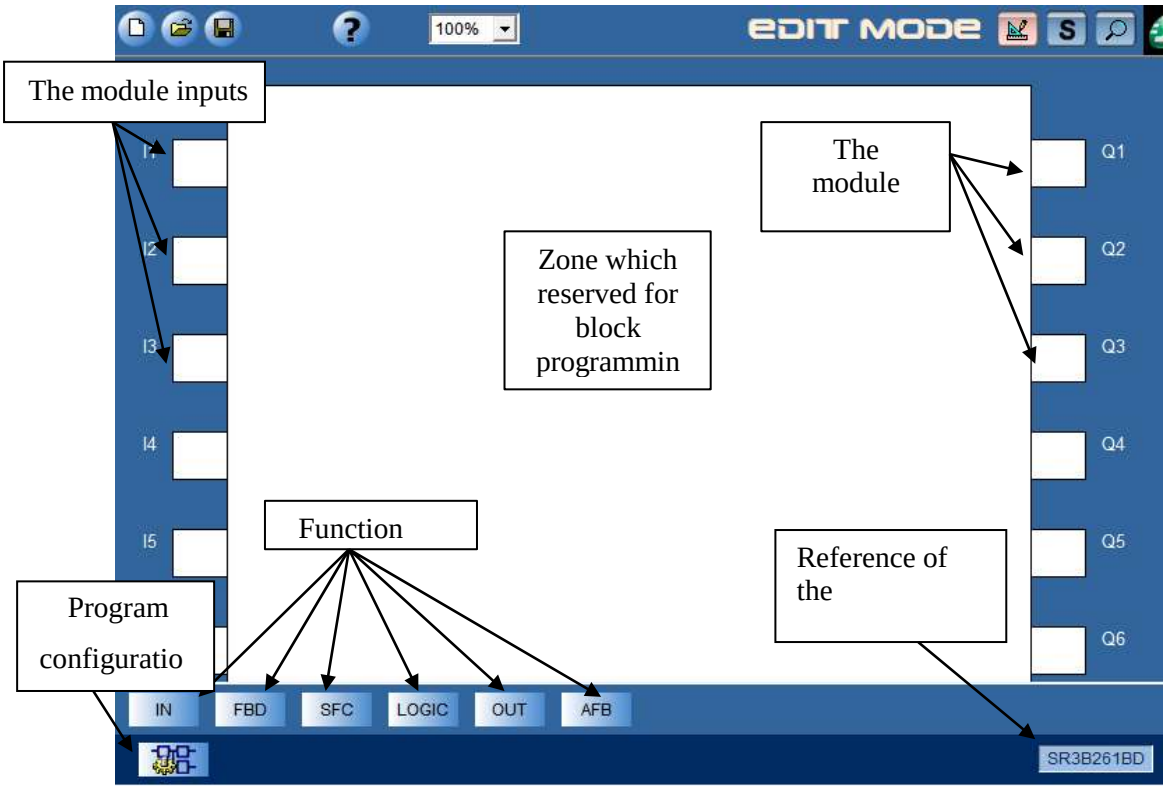


Figure.III.13. The wiring sheet

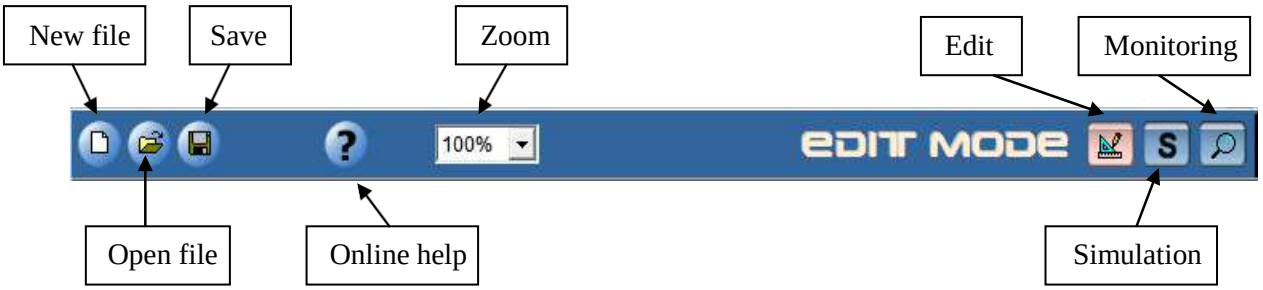


Figure.III.14. Toolbar

Here's some functions that we can find in the FBD [14]

III.1. Inputs assignment

To create an FBD program, the different functions to be inserted in the wiring sheet are available ina function bar. Each of the tabs in the function bar groups a function type.

When the mouse is moved over one of the tabs, the dialog box displays the list of available variables.

The Discrete Input 

function is accessible in the IN function bar.

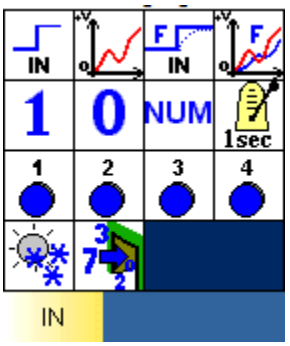


Figure.III.15. Inputs bar

The type of Discrete input can be selected from the Parameters window. This is then displayed inthe Edit and Supervision windows.

Type	Display in the Inactive state	Display in the Active state
Discrete input		
Contact		
Limit switch		
Proximity sensor		
Presence sensor		
Illuminated pushbutton		
Selector switch		
Pushbutton		
Normally open relay		

Table.III.2. Type of discrete inputs

III.12.2.2.2. Function bar assignment

This section describes the different standard functions available.

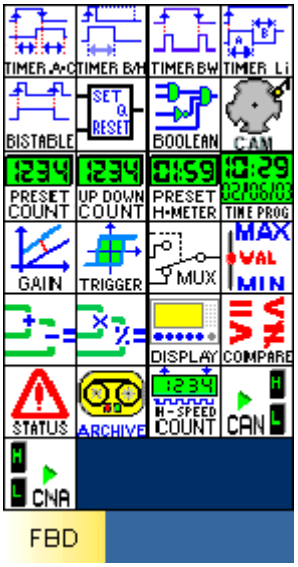


Figure.III.16. Standard functions bar

III.12.2.2.3. GRAFCET assignment

This section provides information on the different SFC (Sequential Function Chart) functions.

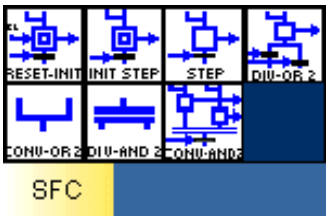


Figure.II.17. SFC functions bar

III.12.2.2.4. Logic blocks functions assignment

In FBD language, it is possible to use logic functions in the block diagrams. The available functionsare

- The NOT function.
- The AND function.
- The OR functions.
- The NAND function.
- The NOR function.
- The EXCLUSIVE OR function.

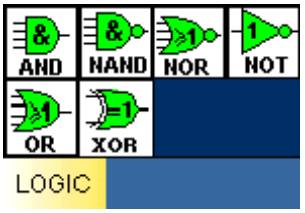


Figure.III.18. Logic functions

Barthe following table shows the various logic functions

Function	Symbol	Description	Number of inputs	Input type
NOT		If the input is inactive or not connected, the output is active. If the input is active, the output is inactive.	1	Digital
AND		If the inputs are active or not connected, the output is active. If at least one input is inactive, the output is inactive.	4	Digital
OR		If at least one input is active, the output is active. If the inputs are inactive or not connected, the output is inactive.	4	Digital
NAND		If at least one input is inactive, the output is active. If the inputs are active or not connected, the output is inactive.	4	Digital
NOR		If the inputs are inactive or not connected, the output is active. If at least one input is active, the output is inactive.	4	Digital
EXCLUSIVE OR		If an input is inactive and the other input is active or not connected, the output is active. If both inputs are active or inactive or not connected, the output is inactive.	2	Digital

Table.III.3. Different logic functions

III.12.2.2.5. Outputs assignment

This section describes the different output blocks available the smart relays feature two types of discrete outputs

- Solid-state outputs for certain smart relays supplied with DC voltage.
- Relay outputs for smart relays supplied with AC or DC voltage.

The Discrete output  function is accessible from the OUT window.



Figure.III.19. Outputs bar

The type of discrete output can be selected from the Parameters window. This is then displayed inthe edit and supervision windows. The selection is made using the output's inactive-state symbol

Type	Display in the Inactive state	Display in the Active state
Discrete Output		
Normally open relay		
Lamp		
Solid state relay		
Valve		
Cylinder		
Motor		
Resistance		
Audible signal		
Green indicator lamp		
Red indicator light		
Orange indicator light		
Indicator light		
Heating		
Fan		

Table.III.4. Type of discrete outputs

III.13. Presentation inputs/outputs

This figure represents all the inputs and outputs of the program such as sensors, motor...

Input	No	Symbol	Function	Lock	Parameters	Comment
I1	B001		Illuminated pushbutton	---	No parameters	start button
I2	B054		Selector switch	---	No parameters	automatic/manual
I3	B304		Illuminated pushbutton	---	No parameters	stop button
I4	B005		Selector switch	---	No parameters	button for vacuum pump
I5	B021		Illuminated pushbutton	---	No parameters	rearmament button
I6	B000		Proximity sensor	---	No parameters	open cartter
I7	B004		Proximity sensor	---	No parameters	thermal relay
I8	B003		Proximity sensor	---	No parameters	air missing
I9	B175		Proximity sensor	---	No parameters	tube insertion
IA	B297		Pushbutton	---	No parameters	pusher
IB	B298		Proximity sensor	---	No parameters	contrast
IC	B299		Proximity sensor	---	No parameters	blocking
ID	B300		Limit switch	---	No parameters	emergency button
IE	B067		Proximity sensor	---	No parameters	tube presence
IF	B309		Proximity sensor	---	No parameters	case presence
IG	B285		Proximity sensor	---	No parameters	leaflet presence

Table.III.5. Program inputs of the machine

Output	No	Symbol	Function	Comment
Q1	B327		Orange indicator light	orange LED of emergency
Q2	B289		Cylinder	selection of product
Q3	B006		Motor	three-phase motor
Q4	B328		Green indicator light	green LED when to motor is on
Q5	B329		Red indicator light	red LED when the motor stoped
Q6	B007		Motor	vacuum pump
Q7	B065		Discrete output	solenoid valve of leaflet
Q8	B174		Discrete output	solenoid valve of case
Q9	B284		Discrete output	ejection section

Table.III.6. Program outputs of the machine

III.14. FBD program

III.14.1. Initial conditions

Any system has initial conditions for a good functioning. If there is one absence if there is one ormore absence of the conditions, it'll provoke stop the system.

In our system, the initial conditions give the permission for the motor get ready.

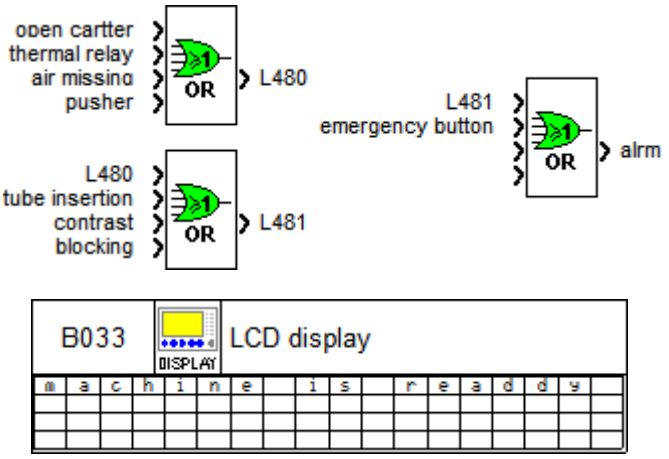


Figure.III.20. Initial conditions

III.14.2. Selection

This operation is repetitive whether there's ointment tube or not.

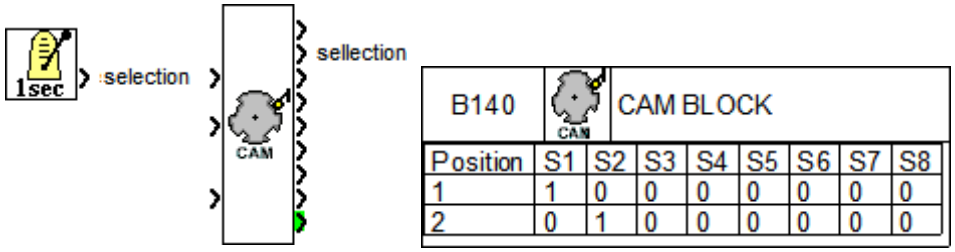


Figure.III.21. Selection

III.14.3. Alarms

An alarm is a danger-warning signal, and its information sent in order to provoke any reaction. Alarms requires prior knowledge of danger, if there is unknown danger involve that there is noalarms shown.

The following figure shows alarm corresponding to the machine and their display

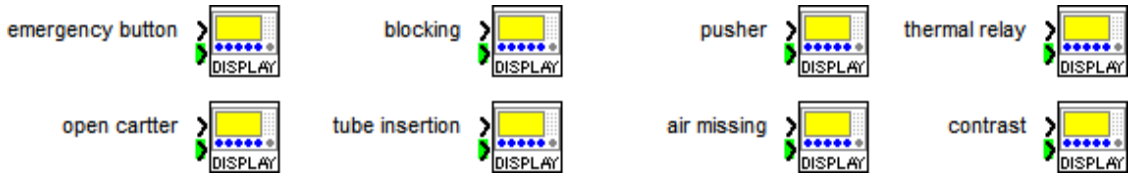


Figure.III.22. Displays

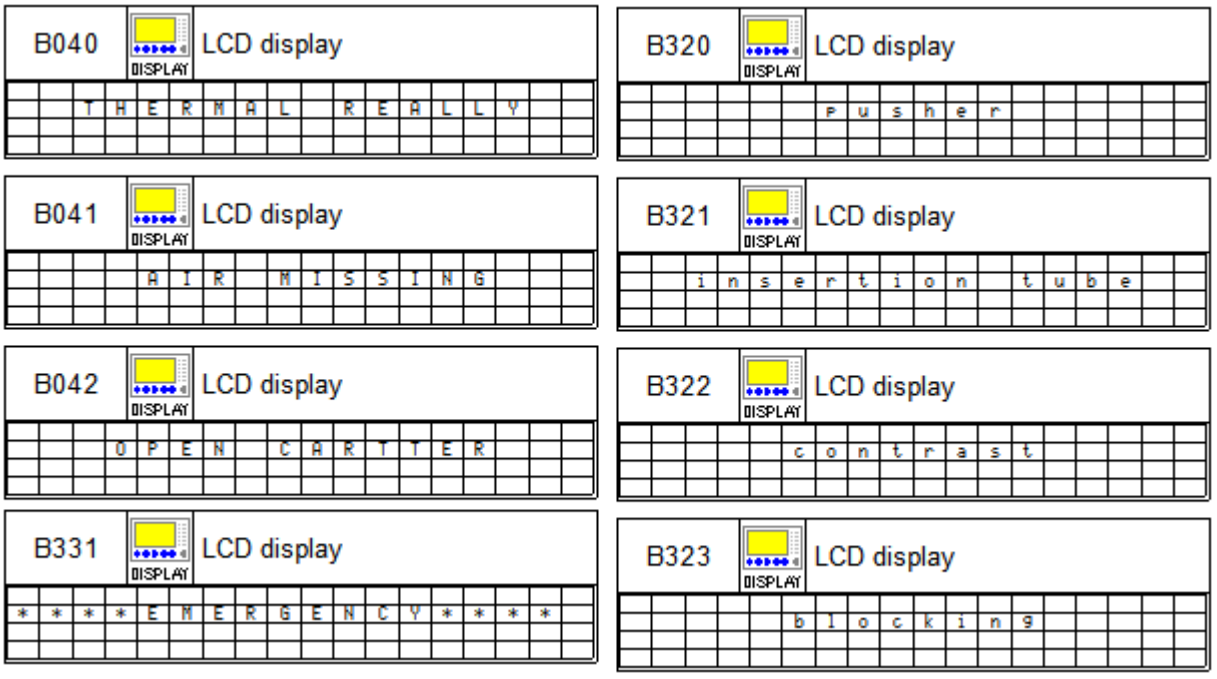


Figure.III.23. Alarms display

III.14.4. Start-up the machine

After checking the initial conditions, the selector switch was selected for machine starting, automatic mode by pressed the start button and select the first position of the selector switch or by manual mode by select at the second position of the selector switch.

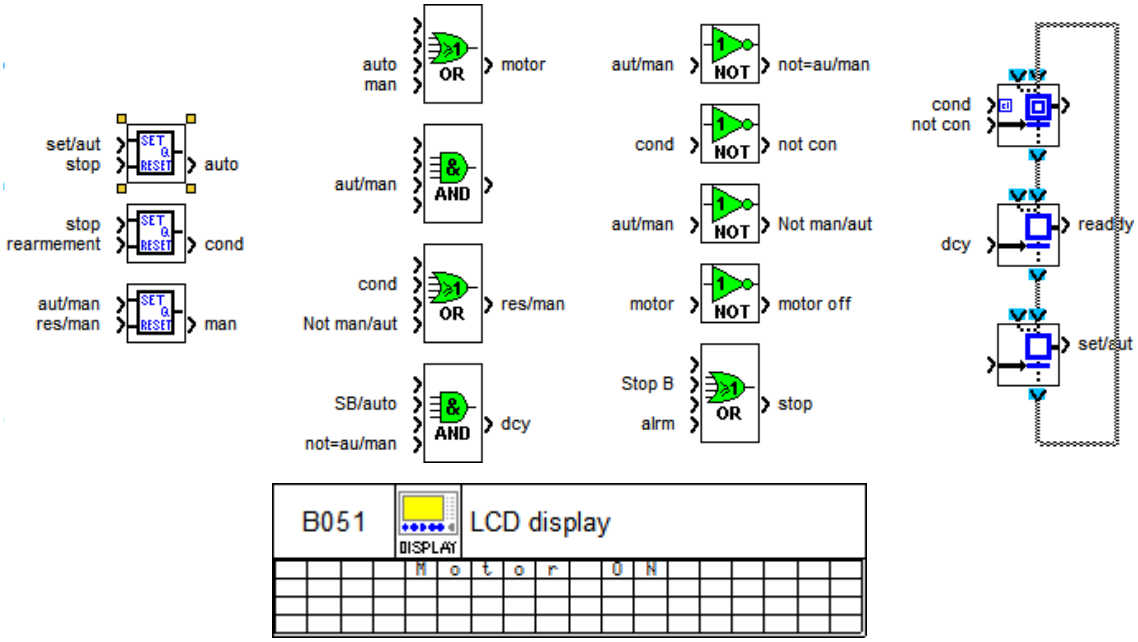


Figure.III.4. Starting up the motor

For the vacuum pump, we use also a selector switch, if it's at the first position the pump is OFF, else if it's at the second position the vacuum pump is ON.

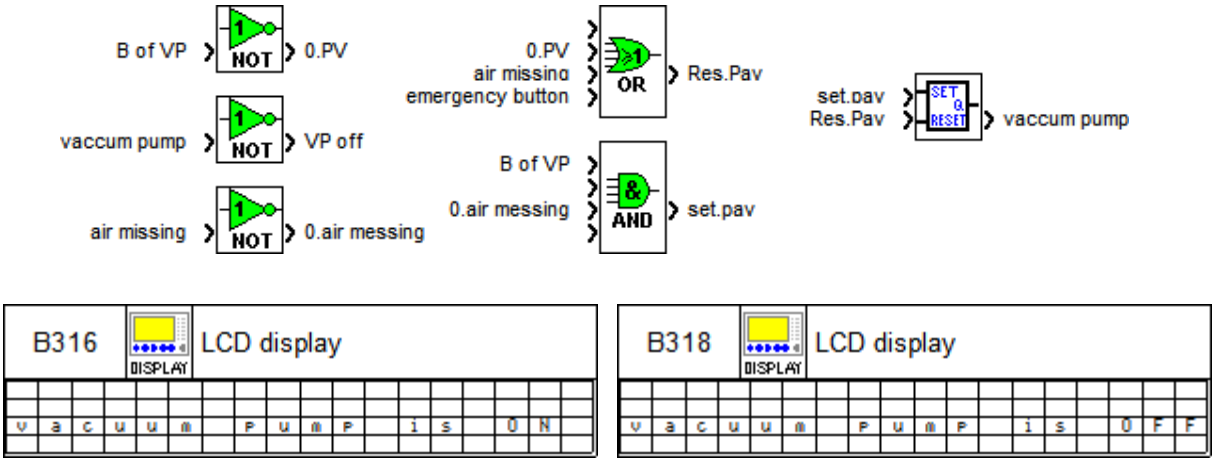


Figure.III.25. Starting up the vacuum pump

III.14.5. Leaflet part

In this part if there's presence of the ointment tube then after three steps the leaflet get down by solenoid valve, this operation is repetitive.

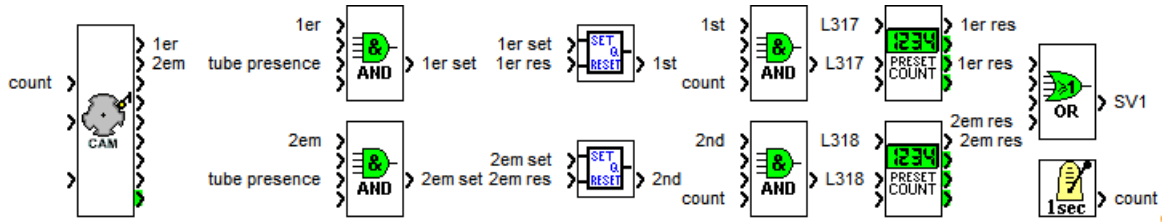


Figure.III.26. Program of leaflet part

III.14.6. Case part

In this part, when the ointment tube get present and the leaflet get down, after another two stepsthose two last get into the case by solenoid valve, and this operation is also repetitive.

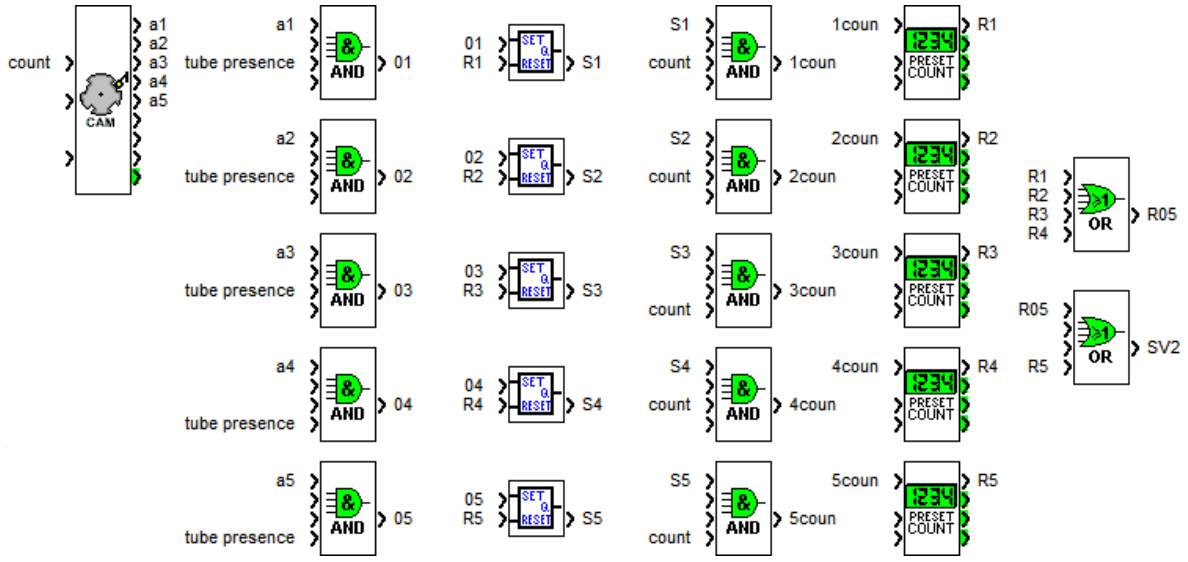


Figure.III.27. Program of case part

III.14.7.Ejection part

If there is absence of leaflet in the operating, the system will continue his functioning and then after twenty step the case will get ejected.

B176	CAM	CAM BLOCK						
Position	S1	S2	S3	S4	S5	S6	S7	S8
1	1	1	1	0	0	0	0	0
2	0	1	1	1	0	0	0	0
3	0	0	1	1	1	0	0	0
4	0	0	0	1	1	1	0	0
5	0	0	0	0	1	1	1	0
6	0	0	0	0	0	1	1	1
7	1	1	0	1	0	0	0	0
8	0	1	1	0	1	0	0	0
9	0	0	1	1	0	1	0	0
10	0	0	0	0	1	1	0	1
11	1	1	0	0	1	0	0	0
12	1	1	0	0	0	1	0	0
13	1	1	0	0	0	0	1	0
14	1	1	0	0	0	0	0	1
15	1	0	1	1	0	0	0	0
16	1	0	1	0	1	0	0	0
17	1	0	1	0	0	1	0	0
18	1	0	1	0	0	0	1	0
19	1	0	1	0	0	0	0	1
20	1	0	0	1	1	0	0	0

Table.III.7. Position of CAM of twenty steps

III.14.8. Three absence consecutive

If there are three absences consecutive of leaflet or cases, the machine will get stop.

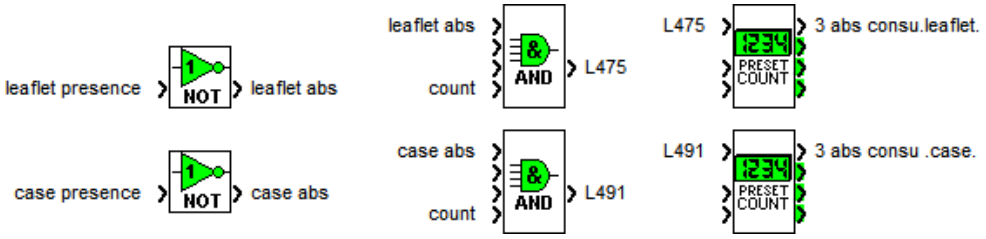
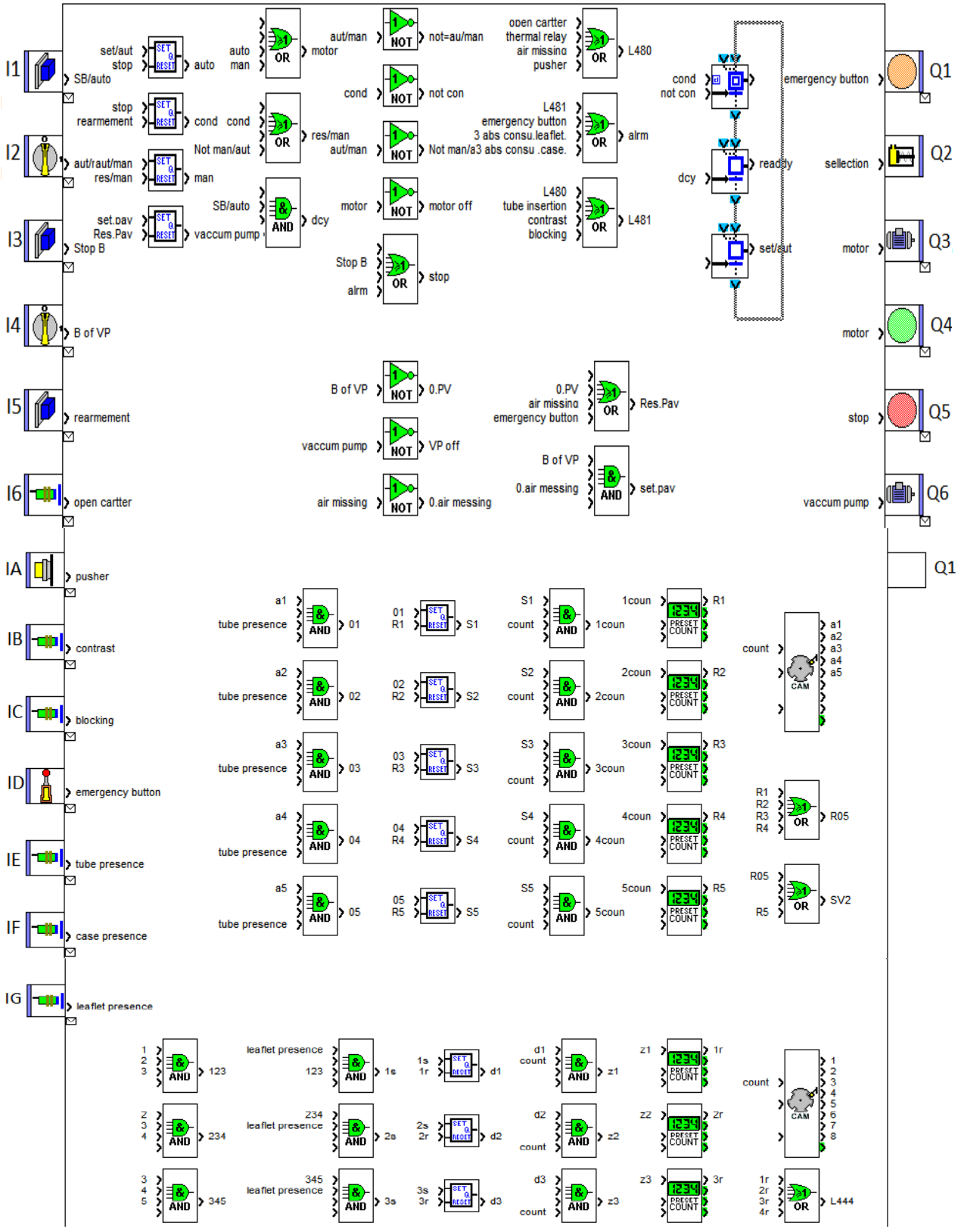
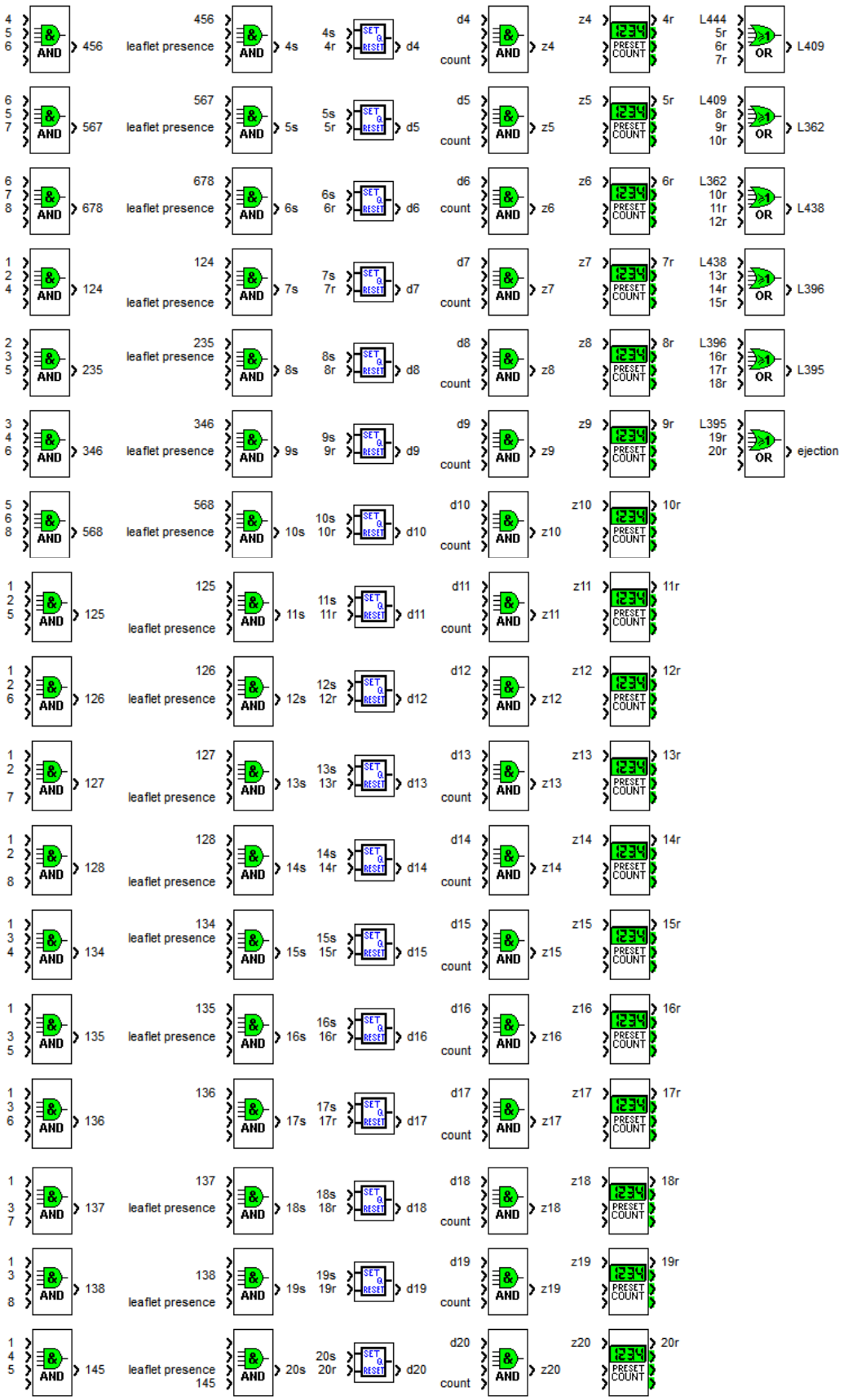


Figure.III.28. Program of three absences consecutive

III.14.9. Final program

In our program we used SFC blocks for an automatic mode working, logical port for assignment input/output, counter, CAM, and rockers (R/S), we also used LCD block (display) for displaying the state of our system.


I1
I2
I3
I4
I5
I6
IA
IB
IC
ID
IE
IF
IG
SB/auto
stop
rearmement
aut/raut/man
res/man
set.pav
Res.Pav
Stop B
B of VP
rearmement
open cartter
pusher
contrast
blocking
emergency button
tube presence
case presence
leaflet presence
set/aut
auto
man
cond
Not man/aut
vaccum pump
aut/man
motor
not=au/man
not con
res/man
Not man/a3
motor off
dcy
alrm
L480
L481
tube insertion
contrast
blocking
0.PV
air missing
VP off
0.air messing
Res.Pav
set.pav
emergency button
ready
sellection
Q1
Q2
Q3
Q4
Q5
Q6
tube presence
count
CAM
PRESET COUNT
R05
SV2
L444


4 5 6 AND 456
456 leaflet presence AND 4s
4s 4r SET Q RESET d4
d4 count AND z4
z4 PRESET COUNT 4r
L444 5r 6r 7r OR L409
6 5 7 AND 567
567 leaflet presence AND 5s
5s 5r SET Q RESET d5
d5 count AND z5
z5 PRESET COUNT 5r
L409 8r 9r 10r OR L362
6 7 8 AND 678
678 leaflet presence AND 6s
6s 6r SET Q RESET d6
d6 count AND z6
z6 PRESET COUNT 6r
L362 10r 11r 12r OR L438
1 2 4 AND 124
124 leaflet presence AND 7s
7s 7r SET Q RESET d7
d7 count AND z7
z7 PRESET COUNT 7r
L438 13r 14r 15r OR L396
2 3 5 AND 235
235 leaflet presence AND 8s
8s 8r SET Q RESET d8
d8 count AND z8
z8 PRESET COUNT 8r
L396 16r 17r 18r OR L395
3 4 6 AND 346
346 leaflet presence AND 9s
9s 9r SET Q RESET d9
d9 count AND z9
z9 PRESET COUNT 9r
L395 19r 20r OR ejection
5 6 8 AND 568
568 leaflet presence AND 10s
10s 10r SET Q RESET d10
d10 count AND z10
z10 PRESET COUNT 10r
1 2 5 AND 125
125 leaflet presence AND 11s
11s 11r SET Q RESET d11
d11 count AND z11
z11 PRESET COUNT 11r
1 2 6 AND 126
126 leaflet presence AND 12s
12s 12r SET Q RESET d12
d12 AND z12
z12 PRESET COUNT 12r
1 2 7 AND 127
127 leaflet presence AND 13s
13s 13r SET Q RESET d13
d13 count AND z13
z13 PRESET COUNT 13r
1 2 8 AND 128
128 leaflet presence AND 14s
14s 14r SET Q RESET d14
d14 count AND z14
z14 PRESET COUNT 14r
1 3 4 AND 134
134 leaflet presence AND 15s
15s 15r SET Q RESET d15
d15 count AND z15
z15 PRESET COUNT 15r
1 3 5 AND 135
135 leaflet presence AND 16s
16s 16r SET Q RESET d16
d16 count AND z16
z16 PRESET COUNT 16r
1 3 6 AND 136
136 AND 17s
17s 17r SET Q RESET d17
d17 count AND z17
z17 PRESET COUNT 17r
1 3 7 AND 137
137 leaflet presence AND 18s
18s 18r SET Q RESET d18
d18 count AND z18
z18 PRESET COUNT 18r
1 3 8 AND 138
138 leaflet presence AND 19s
19s 19r SET Q RESET d19
d19 count AND z19
z19 PRESET COUNT 19r
1 4 5 AND 145
145 leaflet presence AND 20s
20s 20r SET Q RESET d20
d20 count AND z20
z20 PRESET COUNT 20r

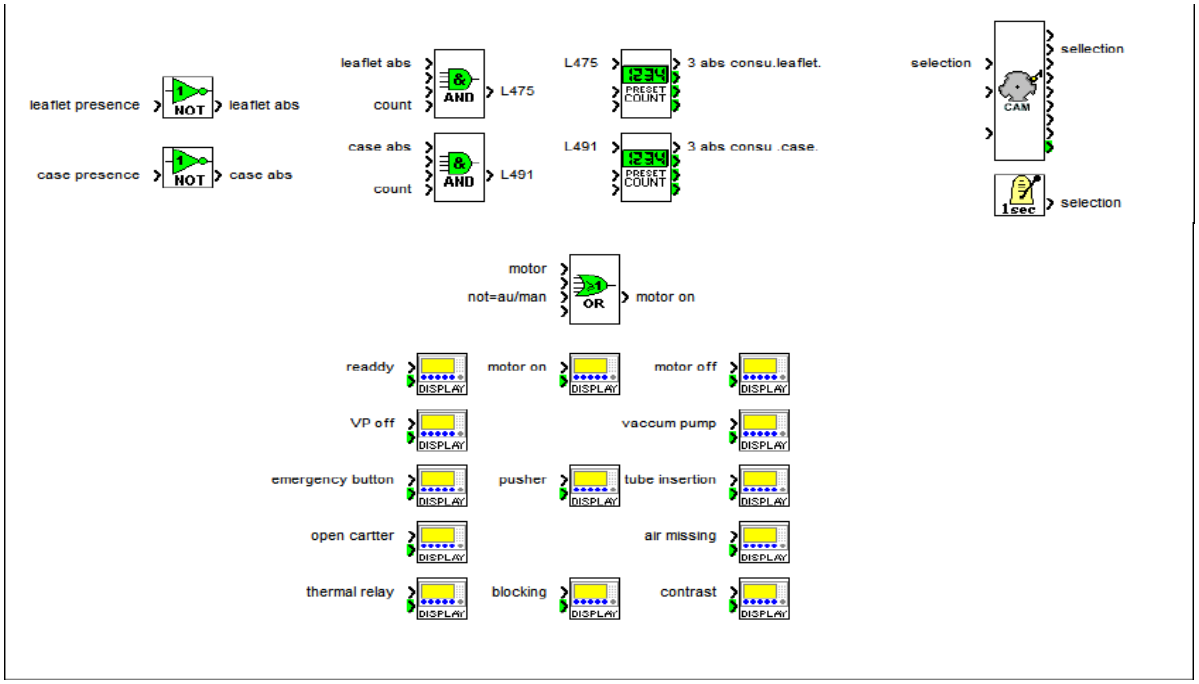


Figure.III.29. Final program

III.15. Program simulation

Before download the program at the controller, it's possible to simulate its execution by checking the program.

In the simulation mode, any action of the user correspond a simulation; its results are displayed in the front panel, edit or supervision window.

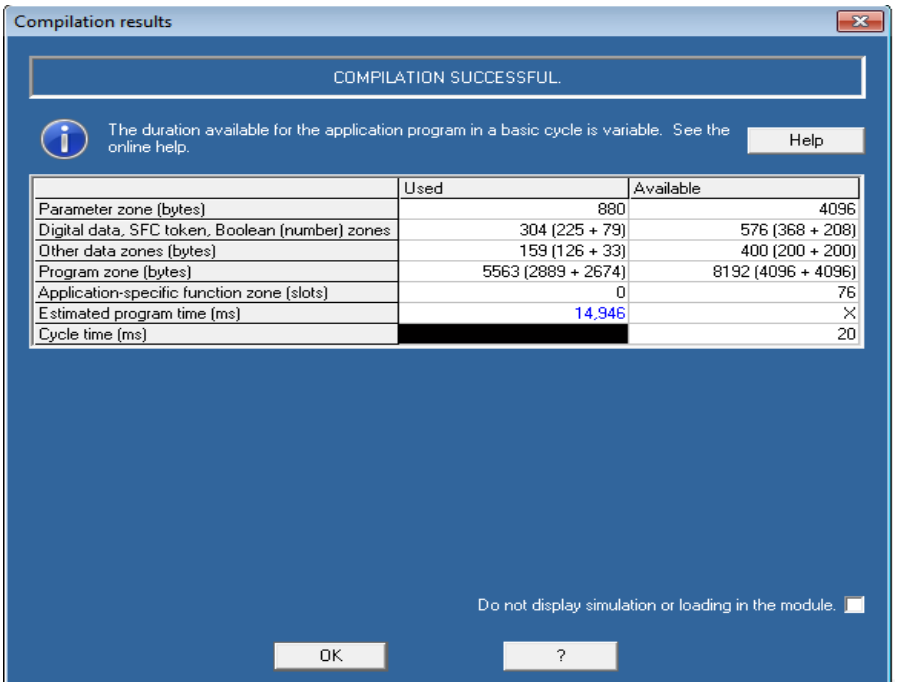


Figure.III.30. Compilation result

III.16. Communication between programming software and PLC

It's possible to use one of the serial links, com port, Bluetooth link, USB link and a connection via modem only for logic modules which has been added in the interface of communication SR3NET01BD.

In this case, the programming workshop tries to connect to the PLC with current parameters, if theconnection configuration is false; an error message means that the device doesn't respond.

III.17. Transfer the program to PLC

Procedure for transferring the program to the smart relay

Step	Actions
1	From the transfer menu, click Transfer Program → PC → Module. Result: The program verification is launched and the Compilation Results window opens.
2	Depending on the results of the verification: • Compilation successful: Confirm with OK. Result: The Write Options dialog box appears. • Failed: Correct the errors and then go back to step 1.
3	Select the Write Options • Protect reading and modification of the program with a password. Refer toAccess/Modification protection of the program saved on the smart relay. • Save modifications before writing. • Start monitoring mode and switch on the smart relay.
4	Confirm that changes by clicking OK. Result: The Write Options dialog box disappears.
5	Launch the transfer by clicking OK in the Transfer Program → PC → Module dialog box.

Table.III.8. Transfer the PC program to smart relay

III.18. Front panel lock

The front panel lock function is used to prohibit access to the menus. Locking is effective when the program is on, but also when it is off. To switch the program "on" or "off" once the lock is activated, we must use the software. Nevertheless, Front Panel Lock doesn't prevent the use of the front panel buttons in a program. When we write the program in ZELIO Logic, the write option window opens. Simply check the ''set lock on front panel of Module ''. After running the program we go to window → 3 front panels

So we got the first display which's "motor OFF" and "vacuum pump is OFF"

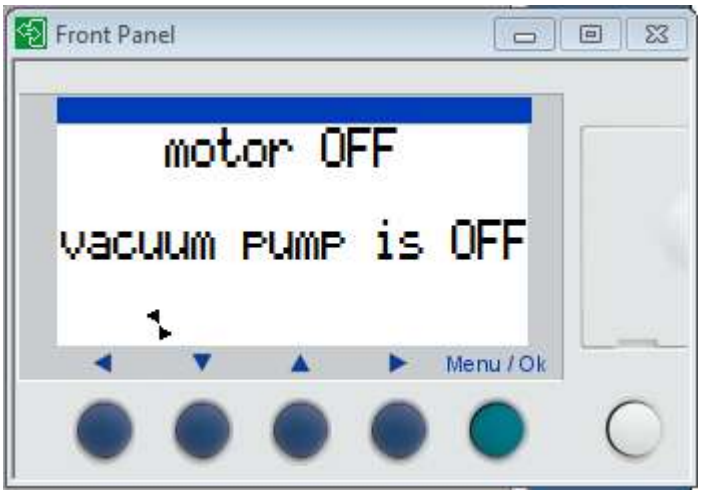


Figure.III.31. Display of motor and vacuum pump OFF

One if we push on rearmament button we get "machine is ready" message

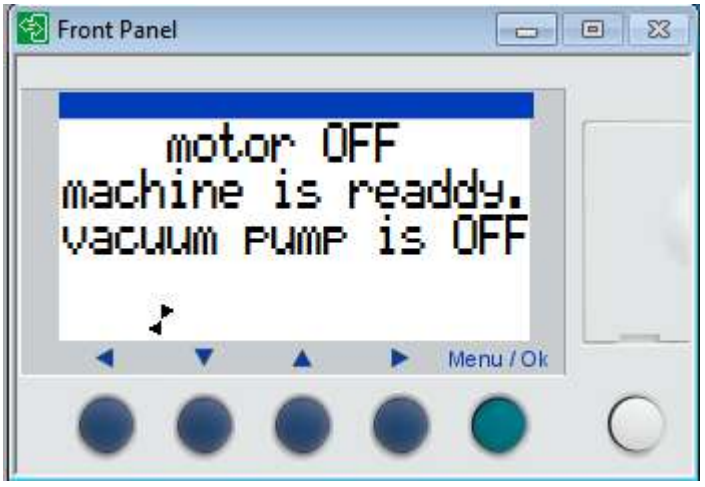


Figure.III.32. Machine is OFF display

If the system is working normally without presence of any alarms, we get

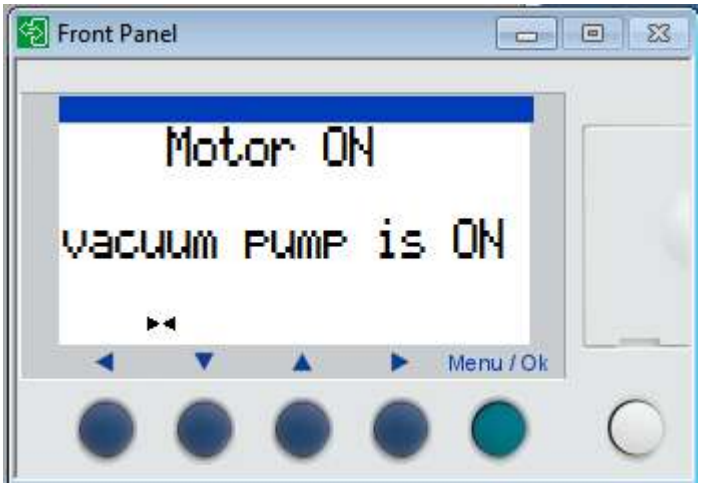


Figure.III.33. Motor and vacuum pump ON display

If there is presence of any alarms the message will be shown by priority, for example if there is air missing the motor will get OFF and the vacuum pump also, so we see the messages of motor OFF, air missing and vacuum pump is OFF, as it shown in the following figure

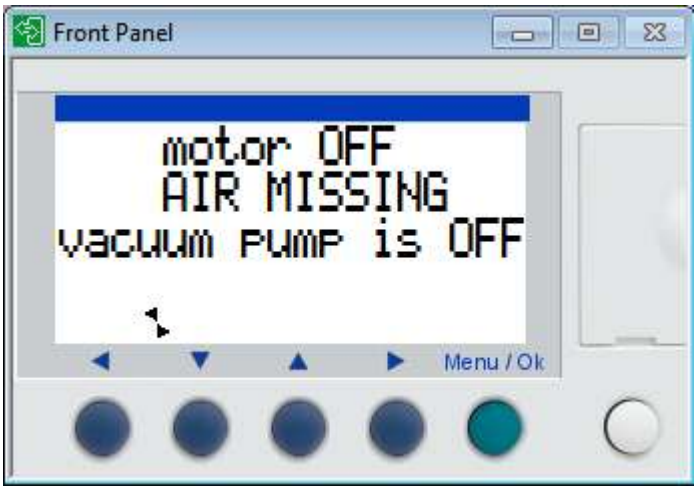


Figure.III.34. Alarme display

III.19. Password functions

If the program is password-protected (key icon appears), we must enter the password to performcertain operations. We follow those steps

Edit→ Program configuration

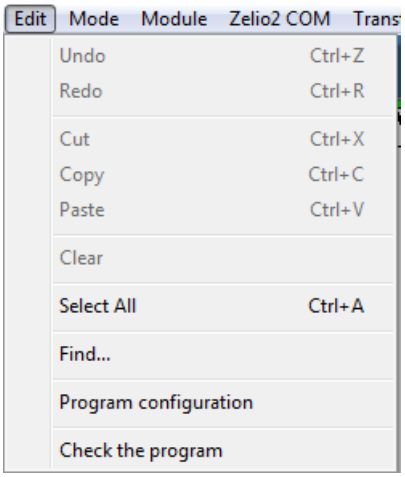


Figure.III.35. Program configuration

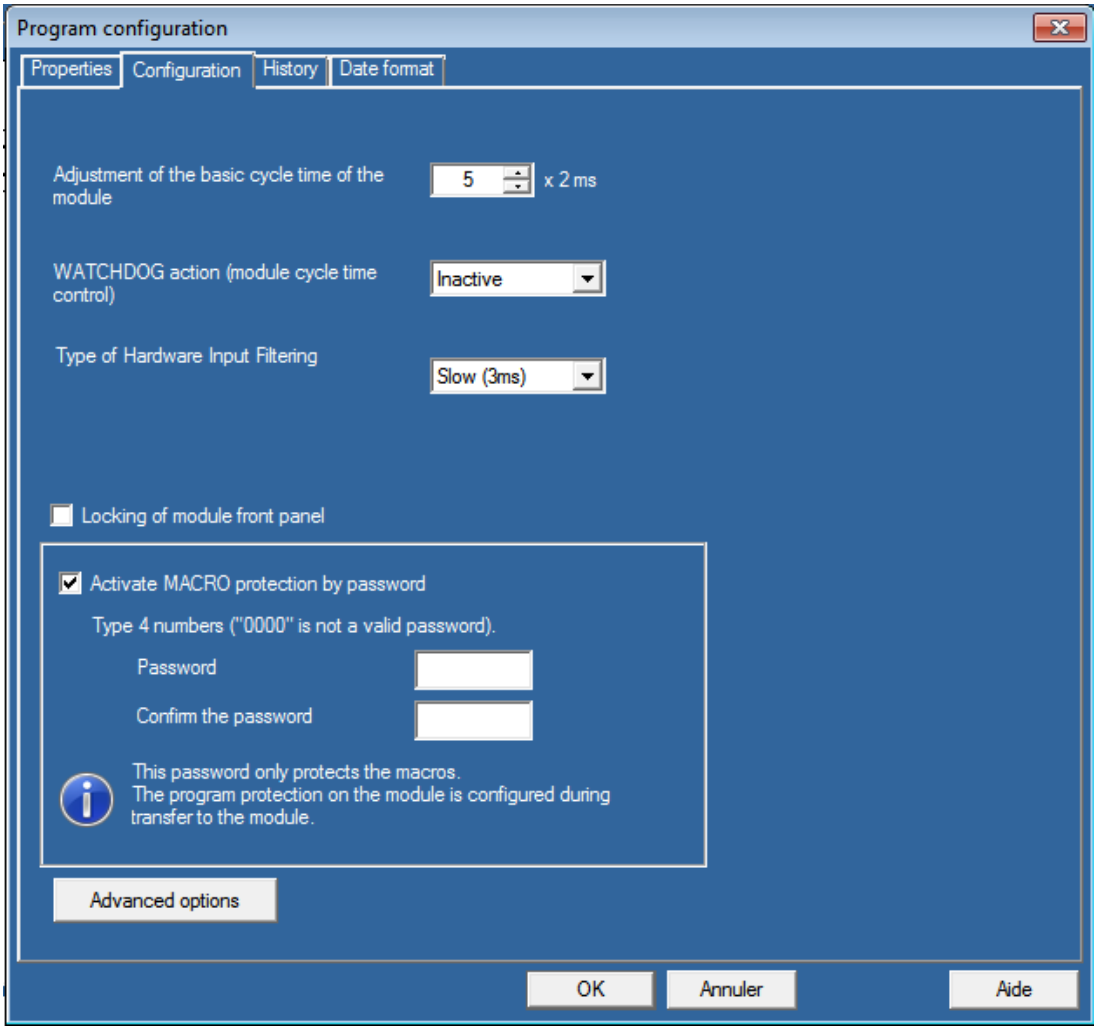


Figure.36. Program configuration window

One we open a system with password the following window will be shown

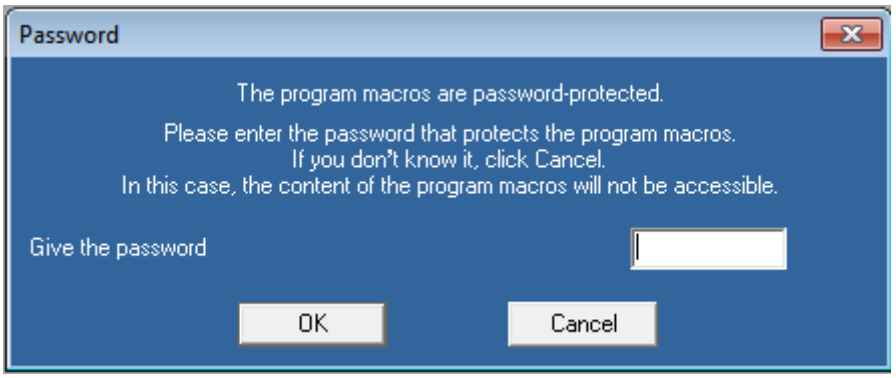


Figure.37. Password window

III.20. Conclusion

We have seen in this chapter our system and how it functioning, then it translates to FBD program, also the choice of ZELIO software that offers us the possibility of programming with FBD language.

The simplicity of programming, so troubleshooting in event of breakdown or modification are two elements take on consideration during this choice and the possibility of following the evolution of the system in monitoring mode, it allow us oversight of the process.

General conclusion

General conclusion

In any automated production system, the right choice of the processing unit is fundamental in view of its very important role in the management of inputs and outputs of the process industrial.

This work allows us to establish a program to control a system and the ZELIO programmable logic controller study and the identification of this automated system studied, as well as the determinationand description of the different step of operation, this end-of-study work is part of the automation of a exhaustion process within the SAIDAL MEMEDEA Group. We have studied the structure of the CAM HF77 machine functioning machine which is an essential part of the product packaging, the objective of our work is done developing this machine by the programmable logic controller and replace the order with electronic cards from certain criteria cite in the third chapter.

We made a program based on the ZELIO PLC in order to solve the problems related to staff safety, memory of steps, and repetitive tasks. We have reviewed the automata industrial programmable controllers from the ZELIO range, their characteristics, selection criteria, advantages, as well as the programming languages that can used.

Indeed, this work to significantly reduce and avoid production stoppages and increase the safety of employers' personnel as well as increase and improve the quality with a reduced economic cost, this work also allows facilitating the task.

This project allowed us to learn about automation and the industrial world, but also to discover the programming of the PLCs. We have learned a lot about the operation of automated systems, as well as APIs.

The work that we do is complementary to all the years that study has the university. He gave us a great contribution, on the one hand, the knowledge, and mastery of new supervision and automation software that are widely used at scale global.

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Annex

The new electrical cabinet

