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Theme

The contribution of programmable logic controllers to industrial systems control

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بسم الله الرحمن الرحيم

Thanks

First of all, I would like to thank Almighty God for giving me the courage and willingness to complete this work. I thank my mother for her support and to my memory photographer, Dr. Lommer Mesbah and Mr. Khaled BLeila, for the time and attention he has gently devoted to the proper functioning of this work.

Dedication:

I dedicate this thesis

To my dear mother,

To my dear father,

To my brothers and sisters,

To my friends.

Chapter (I)

Programmable Logic Controller (PLC)

Chapter (II)

Digital and analog sensor

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PLC : Programmable Logic Controller

PNP : Positive-negative- Positive

NPN : negative- Positive- negative

DC : Direct Current

AC : Alternative Courant

General introduction

General introduction

The pinnacle of modern manufacturing. The discussion over this phenomena has long been contentious, as machines are increasingly replacing humans in a variety of tasks. Unfortunately, people are incapable of performing the jobs that machines accomplish in various domains where manually operated technological equipment is used.

The system has been developed in such a way that it understands how to deal with the situation in which its order has been carried out. Automation technology has advanced to the point where it is now possible to transition from automated machines to automated production systems.

The energy supply is managed by automated production systems, they can improve product quality in addition to ensuring safety and reliability, the process's flexibility, however, leads to an increase in demand, which includes the manipulation of an Automation.

This includes ensuring its management by the large number of variables and the management of the communication flow itself. A programmable logic controller is a device dedicated to the control of a machine or an industrial process, it consists of electronic components, including a memory, which can be programmed by non-computer users in an appropriate language. In other words, a programmable logic controller is a logic computer or computer with a deliberately reduced set of instructions for real-time control and monitoring of inedustriel processes.

The brief consists of three parts:

- Part 1: Talk about the Programmable Logical Controller (PLC) and its types, characteristics and programming.
- Part 2: Talk about sensors, types, characteristics and applications.
- Part 3: Talk about how PLC programming in the industrial field exactly control the machines contain sensors and arms.

Chapter (I)

Programmable Logic Controller (PLC)

I.1. Introduction

The development of methods and features of the limitations, features, and high precision in the science of automated control, where computers and microprocessors were utilized in various control systems, forced the development of what is known as the day with the body of programmed control, PLC.

The operation of a machine is controlled by a dedicated program that is stored within the plc, and the plc then delivers commands to open or close exits that feed the control breaker files in line with the work of the machine whose work is regulated.

As previously said, programmable logical controllers (PLCs) are programmable systems for controlling automated systems, and these controls first appeared in industry in the United States of America in 1969 and France in 1971.

The PLC was created to satisfy the needs of American car manufacturing, who required a one-of-a-kind control unit. These factories employed timers, rulers, and closed loop controllers to accomplish control duties and cascade digital commands before the invention of the PLC. To protect its entire body from confusion, but the annual development associated with the models and models produced made it an annual order of time process of developing the industrial system, as it required the process of re-establishing the systems and subjects of the rulers to the expertise of as an intensive and precise escape to prepare it to its optimum position at work.

So, the PLC was invented to replace that complicated system of thousands of female governors and timers, and in which one plc body was able to program to take the place of that huge equipment of governors and temps, and in which this body adopted large groups of factories that manufacture cars, where the plc re-entry process was replaced in the governors by a program that carried a role for the control units as the product developed.

Thanks to its structure, programmable logical controllers allow changes in the operating sequence of the managed process without having to modify the wires but only modify the software that has been developed according to the software characteristics of the system processors. They are commonly used in critical systems (aircraft, elevators, trains, . . .), so studying them is critical...

I.2.Definition

It is a programmable digital electronic device that can hold a program consisting of a set of commands with specific functionalities. [1]

We define a software logic controller as a particular computer developed for industrial control, and its programming is based on a variety of programming languages, including (Ladder Diagram, Statement List......).

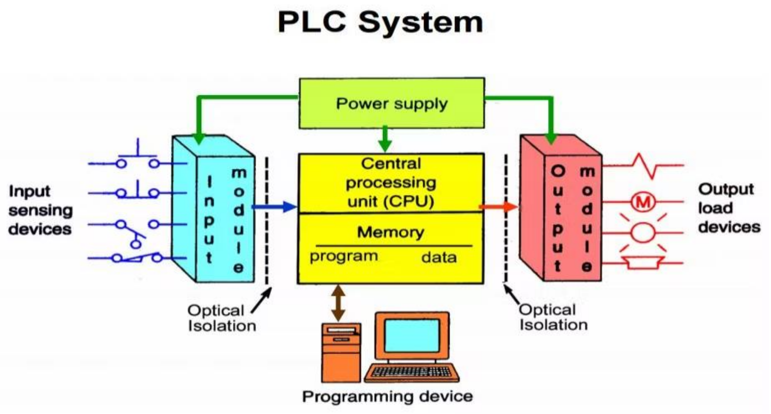


Fig (I .1): PLC System. [30]

I.3.History of PLC

Controlling industrial processes with relays has long been a staple of automated control systems. Resulting in issues such as:

1. Difficulty accessing holidays
2. Difficulty in modifying circles
3. Relay circles need a lot of space

A group of engineers from the General Motors system created the first PLC. Control over the development of automobiles Since 1969, when the first PLCs were put in industries, they have proven to be effective.

Jaw comfort, installation, programming, and modification are all excellent. Then he reappeared in the 1970s.

Micropressor technology has been used in the manufacture of. PLC May gave an advantage to PLC systems

The ability to control complex industrial processes

I.4.PLC Features

1. Flexibility of control and this to facilitate the performance of industrial processes that keep pace with future expansions.
2. Ease of maintenance because these devices are designed to detect faults and their causes through data
3. It has different sizes, making it easy for the user to choose
4. Its high potential can solve more than 500 relays and contactors, 32 different types of counters, 32 different types of timers, in addition to internal storage relays.
5. Its high ability to perform logical arithmetic operations that serve industrial applications
6. PLCs can work alone or in a local network
7. Information can be transferred via the Internet (it varies according to the type of device)

I.5.PLC machine function

The PLC units carry out the required operational functions based on the operating program stored in their internal memory, where they monitor the entries and then make judgments based on the directives supplied to them, which are then implemented on the exits. [2]

I.6. Key components of PLC unit

The PLC unit consists of the main components:

- Input module
- CPU
- Output module
- Power Supply unit
- Operator unit
- Programming Device
- connection cable

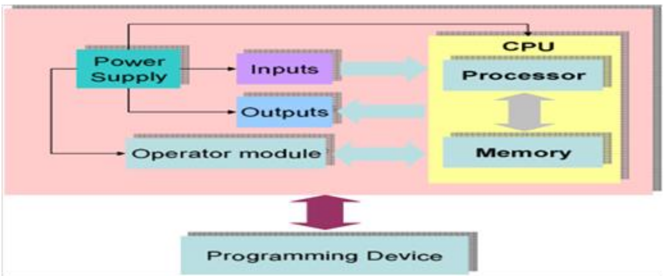


Fig (I .2): Key components of PLC unit. [31]

I .6.1. Input Module

It accepts the input signals and prepares them for processing by the central processing unit. There are two different kinds of entrances:

I .6 .1.1. Digital input:

It can be stated in two ways: ON or OFF (such as a compressor switch, a proximity sensor,)

I .6.1.2. Analog input:

Its shape and value are both flexible (such as a liquid level sensor, where the voltage decreases and rises according to the decrease and height of the liquid level).

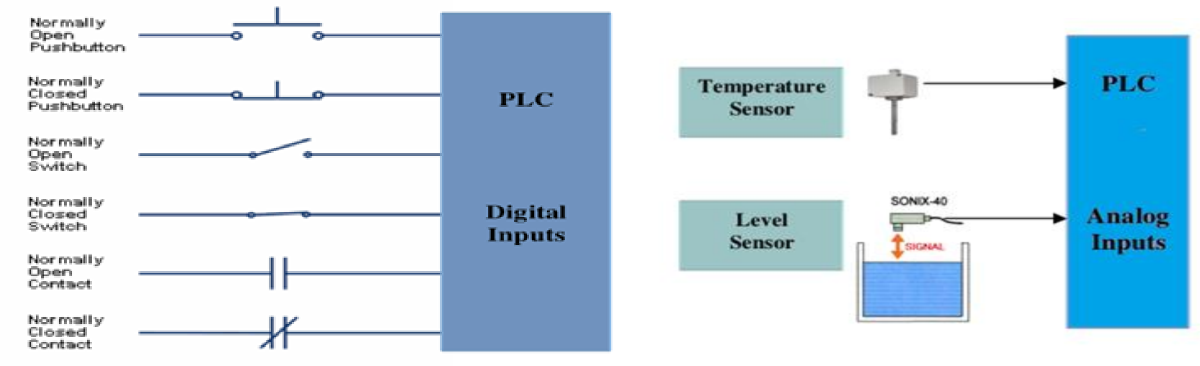


Fig (I .3): Digital input and Analog input. [32]

I .6.2. Output Module

It generates the necessary electrical signals for control. They are either digital (bulb, LED, etc.) or analogue (bulb, LED, etc). (temperature control, ...)

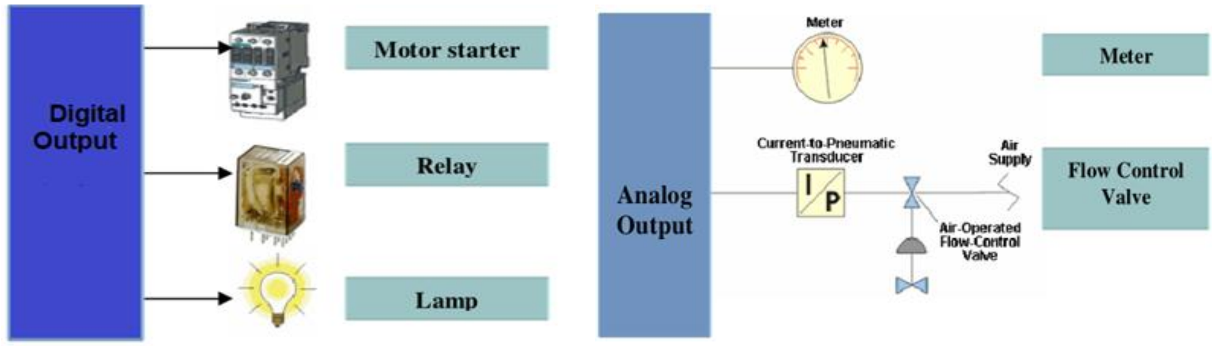


Fig (I .4): Digital output and Analog output. [32]

I.6.3.CPU

It is a microprocessor that holds system memory and serves as the PLC unit's decision-making center, and it performs the following functions:

- Receive and process the input unit's logical signals.
- Take appropriate decisions according to the instructions stored in the program's memory.
- Issuing control commands to the output unit according to program instructions stored in memory

- The CPU unit performs many operations such as counting, timing, data comparison, sequential operations and shifting.

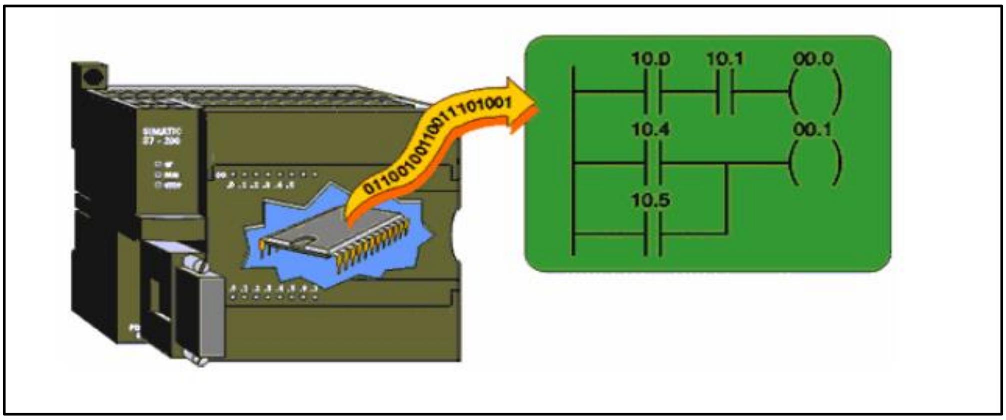


Fig (I .5): CPU. [32]

I.6.3.1. Memory unit

There are two main types of memory in the PLC unit:

- **Random memory (RAM**) is a type of memory that may accept data from any address. This memory can also be used to write and read data. It's a temporary, non-permanent memory. This means that if the electrical power that powers it goes out, the data stored in it will be lost. As a result, a battery is fitted to prevent data loss in the case of a loss of electrical power to the device. [4]

This memory is divided into:

- **Read-only memory (ROM)** is a type of memory that allows data to be read but not written to. This memory is used to prevent data or programs from being wiped, and it is permanent memory, which means the data put in it will not be lost.

✓ Erasable Programmable Read-Only Memory (EPROM)

Although it is a read-only memory, data can be deleted from it by exposing it to ultraviolet radiation, making it ready for fresh data to be written by its own data writer.

✓ Erasable and electronically programmable read-only memory (EEPROM),

Although it is a read-only memory, the data contained in it can be deleted by turning it on (Unprotected Mode) and entering data.

I.6.4. Power Supply

It is composed of a step-down transformer and a unifying circuit

A step-down transformer converts alternating current voltage to another alternating voltage of lower value

The unifying circuit converts alternating current into direct current without changing the voltage value

Note:

- ✓ The use of the feeder depends on the type of PLC:
- ✓ He finds some types that work with 220V AC, so in this case it is connected to the electricity source directly and the (power supply) is not used.
- ✓ From the inside, the PLC contains a rectifier unifying circuit to improve the constant current as much as possible
- ✓ In some cases, during connection, we may need to use more than one power supply at the same time, and in this case, it is preferable to connect the negative terminal of all the feeding units used together to ensure the equal balance of voltage coming out of the feeding units.

I.6.5. Programming device

It is a special device that is connected to the PLC unit and is used in the following

- The program is written in it
- By which the program is transferred to the PLC unit
- The computer can also be used as a programming device for the PLC unit

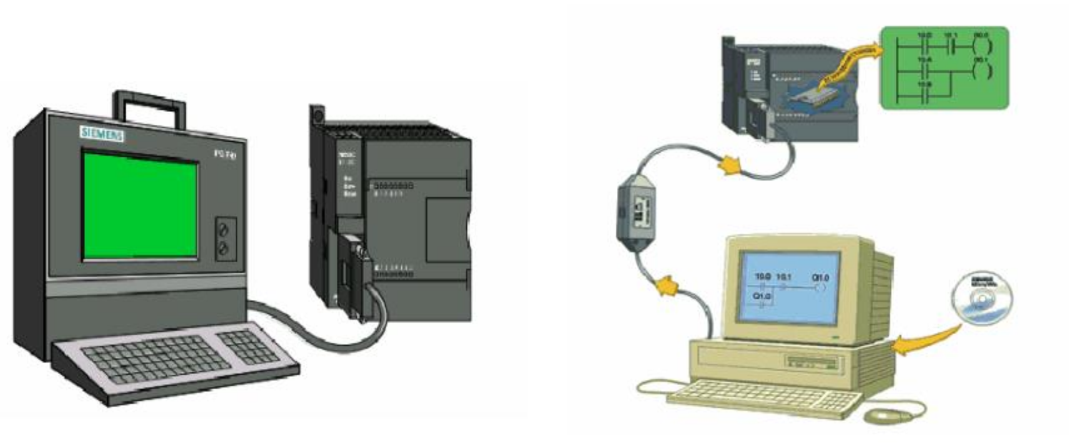


Fig. (I .11): Programming device. [32]

I.6.6. connection cable

To transfer the driver program from the programming device to the PLC unit or to download the driver program from the PLC unit to the programming device, a direct connection is formed between the PLC unit and the external programming device (computer). This connection is made utilizing bespoke characteristics between the unit and the programming device. There are modern types of the type (USB) to simply deal with the laptop outputs of the same type, and it permits communication between the (PLC) device and the computer through the series port.

- There are two types of communication cables
  - POIT TO POINT INTERFACE (PPI): It is used to connect only one device with the PLC unit.
  - MULTI - POIT TO POINT INTERFACE (MPI): It is used to connect more than one device with the PLC unit at the same time

I.6.7. Operator Unit

This unit enables the operator to:

- Display the information of the various controlled processes.
- Introducing new factors or modifying used factors

Fig. (I.13): Operator Unit. [32]

I.7.Extension Module (Additional input or output units)

Because the programmer may require a set of additional inputs or outputs in some instances [3], units containing a specified number of inputs only, units containing a specified number of outputs only, or units containing a defined number of inputs and outputs together are available for purchase.

I.8. Programming the PLC unit

- What is meant by programming language is the method used to draw and write a program designed to perform a specific function.
- Each company that produces PLC units has its own programs for writing and drawing the program, but as we said in the end, all of them perform the same required function. The methods used to write and draw the program.
  - Ladder Logic
  - Statement Lists
  - Function Block Diagrams
- Each of the previous methods is used to write the program and each has its own advantages and disadvantages. Here in most Arab countries and some European countries, the LADDER (LD) method is used.

I.9. PLC Types

On the market, PLCs come in a variety of sizes and capacities, and the designer must choose the right one for the job. You have certain businesses that are geared at the public market.

- Siemens
- ABB
- HIMA
- LG
- ALEN BREADLY
- Omron

I.10. Use PLC programmer devices

PLCs have been utilized in a wide range of advanced industries, including automotive, chemical, iron and steel, petroleum, paper and printing, food production lines, and a variety of textile industries.

I.11. Conclusion

PLC functions have evolved over the years to include sequential monitoring, motion control, process control, distributed control systems, and networks. Data processing, storage, processing power, and communication capabilities of some modern PLC control systems are almost equivalent to desktop computers. PLC-like programming along with I/O devices allows general-purpose desktops to interfere with some logical programmable controllers in certain applications. Desktop controls are generally not accepted in heavy industries because desktops operate on operating systems that are less stable than programmable logical control systems, and because desktop computers are not usually designed at the same levels as temperature, humidity, vibration and longevity. Processors used in PLCs.

These manufacturing industrial processes usually have a high automation system development and maintenance cost relative to the total cost of automation, and where system changes are expected during its operational life. Programmable logical controllers have input and output devices compatible with industrial pilot devices and controls; little electrical design is required, and the design problem is focused on expressing the required sequence of operations. PLC applications are usually highly customized systems, so the cost of packaged PLC is low compared to the cost of designing a specific custom controller. On the other hand, in the case of mass-produced goods, custom control systems are economical. This is due to the low cost of components, which can be optimally selected instead of the "general" solution, and where one-time engineering drawings are distributed to thousands or millions of units.

In the end, the location of the PLC unit in the factory should be far from the water's location and away from the workers, i.e. in a secluded room and equipped with remote alarms in case of any error.

Chapter (II)
Digital and analog sensor

II.1. Introduction

We can find sensors everywhere, and the whole world is full of sensors and their applications. There are many types of sensors available around us, in our offices, gardens, shopping malls, homes, cars, toys etc. These sensors make our lives so easy and comfortable, starting from applications such as switching on the lights, fans, television (TV), automatic adjustment of the room temperature by air conditioning (AC), fire alarm, detecting obstacles when the car is reversing, making a thumb impression etc. A sensor is a device which receives signals as well as responding to a signal or stimulus. The stimulus signals can be defied by the measure, property, or state which is sensed. We also can say that a sensor is a translator that converts a nonelectrical value to an electrical value [1–3]. The output signal of a sensor may be in the form of voltage, current, or charge. A sensor has many forms of input properties and electrical output properties. If there is small change in the sensed quantity, it will cause a small change in the electrical output and the changes can be detected with their measuring capabilities. All the sensors are categorized on the basis of their uses, applications, material used and some production technologies. Some sensors are classified also by their characteristics such as cost, accuracy or range of sensor. There are two main types of sensors: passive sensor and active sensor. A passive sensor does not require any extra energy source and electric signal is produced directly in reply to stimulus of external sources. This means that the sensor converts input energy to output signal energy [1, 4, 5]. Examples of passive sensors include photographic, thermal, electric field sensing, chemical, infrared and seismic. The active sensors need external sources of energy for their response, known as excitation signal. To produce the output signals, sensors adopt necessary changes to these input signals. Active sensors are also known as barometer sensors because of their own properties that can be modified in response to an external effect and can then be changed to electrical signals. Active sensors have a variety of meteorological and surface observation applications and atmosphere. Differences between passive and active sensors. Other types of sensors rely on their detection properties such as contrast mechanism, analog and digital. The detection properties of sensors include electric, magnetic, physical, chemical etc, and variation mechanism includes conversion of the input signal to output signal, whose examples are photoelectric, thermoelectric, electrochemical, electromagnetic etc. Analog sensors produce an analog output, i.e. continuous output signals are produced with respect to the measured quantity, but a digital sensor is the opposite of analog sensors, with discrete characteristics and digital output in nature. Sensors are also divided by their detection properties

II.2. Digital Sensor

Sensors, everything or nothing

II.2.1. Limit switch

The end of limit switch is an electromechanical key that changes its contact points when physical force is applied to it by an object. [5]

The end of limit switch is a two-part **acuator** device and **electrical_switch**

- **Acuator:** Moves when pressed by a physical body
- **Electrical switch:** Opens and closes when acuator moves

Fig (II.1): Limit switch

II.2.2. Proximity Sensor

It comprises of the sensor's face and sensor body, which senses the closeness of items to other objects and delivers a signal in the form of an electrical signal. [6]

Fig. (II.2): Proximity Sensor

- **Sensor face:** It's part of the sensor used to detect targets.
- **Sensor body:** Inside the sensor's body is where the electrical circuit turns on the sensor.
  - ☒ The sensor sends a 24-volt DC crappy effort when things approach it at a specified distance.

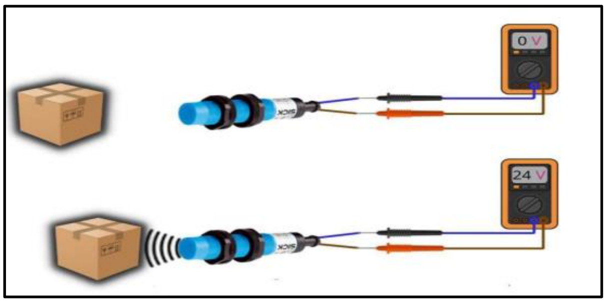


Fig. (II.3): Sensor face

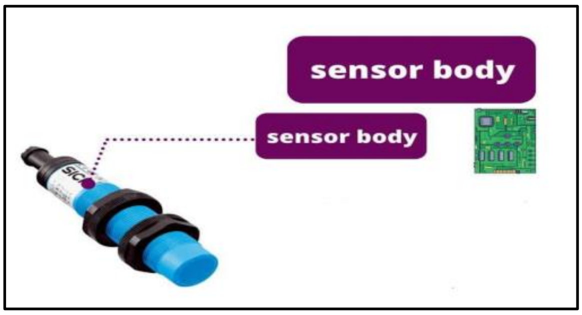


Fig. (II.4): Sensor body

II.2.2.1. Inductive proximity sensor

Sensors that detect the movement or existence of metal objects without any physical touch or contact and send an electrical signal, but no mechanical movement, such as **shielded** and **unshielded** sensors.

- **Shielded sensor**: That is, the sensitive object is covered with a thin coating of metal, particularly on its surface, and the importance of the shielded type focuses the magnetic field on the sensor's surface, resulting in improved accuracy.

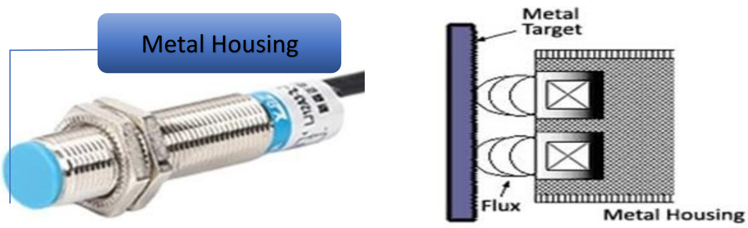


Fig (II.5): Shielded sensor. [33]

- **Unshielded sensor:** Because there is no metal layer in this type, the magnetic field is more expansive.

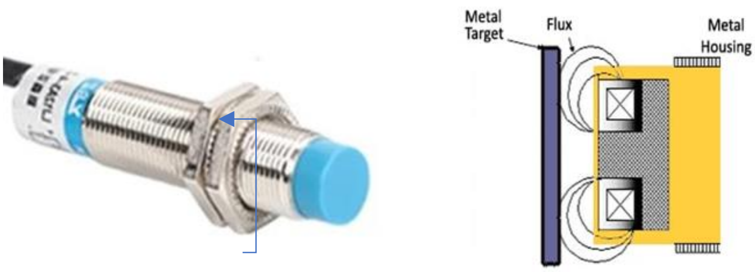


Fig (II.6): Unshielded sensor. [33]

II.2.2.1.1. Inductive proximity sensor working principle

The sensation produces a magnetic field of a specific strength, and as a metal object approaches, the sensation produces circuitry that weakens the magnetic field. This is supported by the Trigger circle, which is positioned within the sensation. [7]

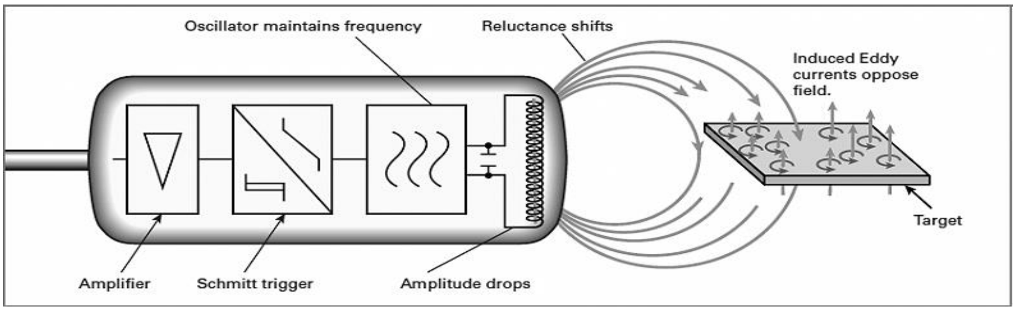


Fig (II.7): Inductive proximity sensor working principle. [34]

II.2.2.1.2. Main Components of Inductive Proximity Sensor

An inductive proximity sensor consists of four elements – the coil, the oscillator, the trigger circuit, and an output. [8]

- **Coil:** The electromagnetic field is generated by the coil. The coil is held inside a cup-shaped ferrite magnetic core. To focus the coils, a cup-shaped core is required. On the front of the sensor, there is a magnetic field.

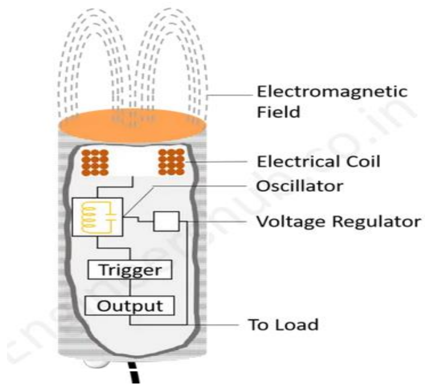


Fig (II.8): Main Components of Inductive Proximity Sensor. [35]

- **Oscillator:** In most cases, the oscillator is an LC oscillator. It generates an electromagnetic field by producing radio frequency (100 kHz to 1 MHz).
- **Trigger Circuit:** The trigger circuit detects changes in oscillation amplitude and sends the signal to a solid-state output.
- **Output Circuit:** A transistor, either NPN or PNP, is used in the output circuit. The transistor turns on and produces an output after receiving the gate signal. [35]

II.2.2.1.3. Sensor delivery method in electrical circuits

In order to implement close sensors in electrical circuits, there are two more common types of two-tip sensor (2 wire) and three-tip sensor (3 wire), with 4 and 5 wire

- two-tip sensor (2 wire): One end of the sensor is connected to the current and the other end to the load and then the other end of the load to the second end of the current source.

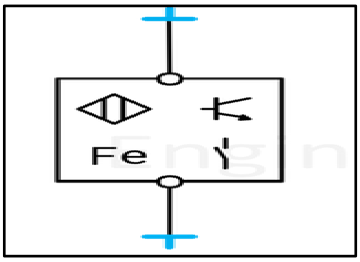


Fig (II.11): sympol of sensor. [35]

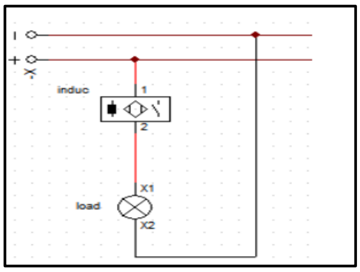


Fig (II.10): Delicate connection in electric circuit

- three-tip sensor (3 wire): There are two types of PNP and NPN and the way they connect as follows

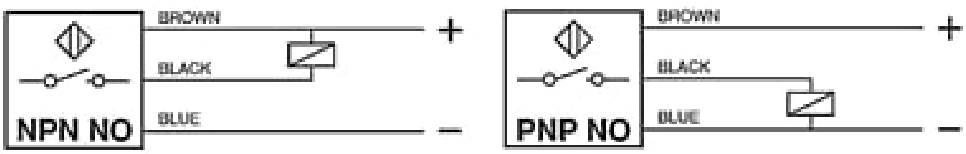
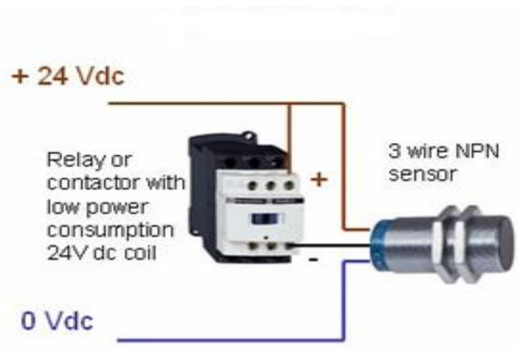


Fig (II.12): Sensor Delivery Method PNP and NPN. [36]



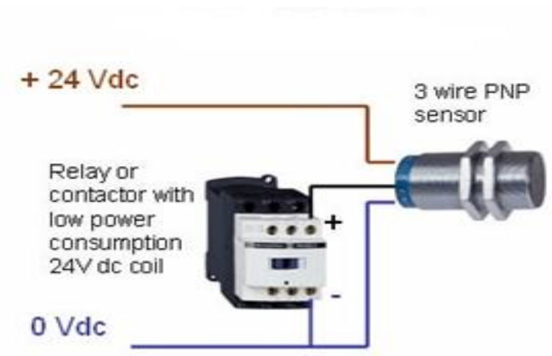


Fig (II.13): 3 wire NPN wiring. [37]

Fig (II.14): 3 wire PNP wiring. [37]

☒ Blue Wire : negative nutrition.

- ☒ Brown Wire : Nutritional
- ☒ Black Wire : Signal Output

  - Observations :

1. The distance between sensor and body is as little as 60 mm
2. For a sense that only feels metal objects
3. It is influenced by the surrounding factors such as temperature and others.

II.2.2.2. Capacitive proximity sensor

The Saudi convergence sensor detects all materials, including metals and non-metals like paper and glass, and also feels fluid.

Fig. (II.14): Capacitive Proximity sensor. [38]

II.2.2.2.1. Capacitive proximity sensor working principle

When an object approaches, the Saudi sensor acts as a simple condenser, with the metal plate at the front electrically connected to an internal oscillator circuit and the body to be felt acting as the second plate of the condenser. When an object approaches, the capacity of the sensor increases until it reaches a level that makes the sensor a day by releasing its signal. [9]

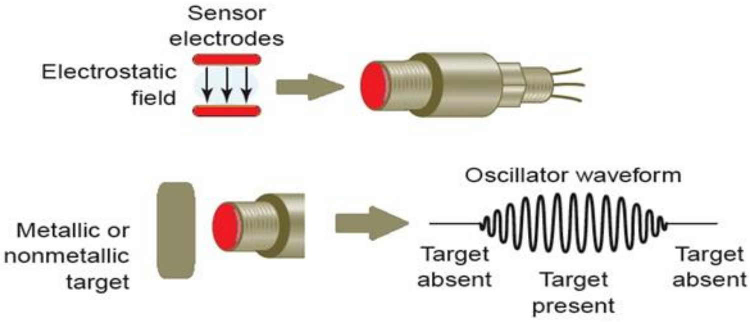


Fig (II.15): The idea of a capacitive sensor's work. [39]

- **Observations**:

1. The sensor delivery in the circuit is the same as the inductive convergent sensor
2. Unlike the inductive sensor that produces an electromagnetic field, the Saudi sensor produces an electrostatic field.
3. The sensor makes sense of metals as well as non-metallic materials such as paper, glass, liquids and cloth
4. Large increases in sensitivity can cause sensitive impact on temperature, humidity and dirt.
5. Saudi sensors have the ability to adjust sensitivity.

II.2.3. Photoelectric Sensor

It is a gadget that detects the presence or absence of items using light and is capable of detecting metal, plastic, and wood.

II.2.3.1. Photoelectric Sensor working principle

By transmitting light, photovoltaic sensors can detect the presence of an object. The body is detected using an electro-sensor since the level of light receipt varies in comparison to the light emitted by it. It's possible that the light **emitted** by infrared PV sensors will be visible. A light emitter and a light receiver are the main components of a photovoltaic sensor. The amount of light that reaches the **receiver** changes as the light emitted is stopped or reflected by the sensor body. This change is detected by the receiver, which converts it to an electrical output. [10]

- **Emitter:** Light Emitting Diode (LED) or Laser Diode is used as Emitter.
- **Receiver:** Photo Diode or Phototransistor Is Used as Receiver.

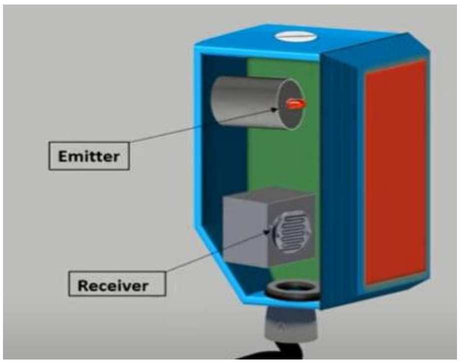


Fig (II.16): Photoelectric Sensor

II.2.3.2. Types of Photoelectric sensor

There are three types of photoelectric sensors:

II.2.3.2.1. Through-Beam Optical sensor:

Emitter and receiver are situated opposite each other in these sensors, as shown in the diagram. When an object passes between two beams, the beam is disrupted. These disruptions are utilized to detect whether or not an object is present.

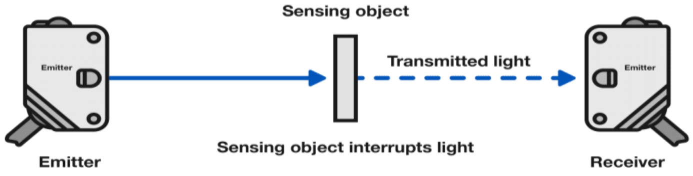


Fig (II.17): Through-Beam Optical sensor. [40]

II.2.3.2.2. Retro Reflective Optical Sensors:

The Emitter and receiver are housed together, and light from the Emitter is generally reflected back to the Receiver by a reflector on the other side of the housing. The amount of light received is reduced when the detecting object disrupts the light. This light intensity reduction is utilized to detect the object.

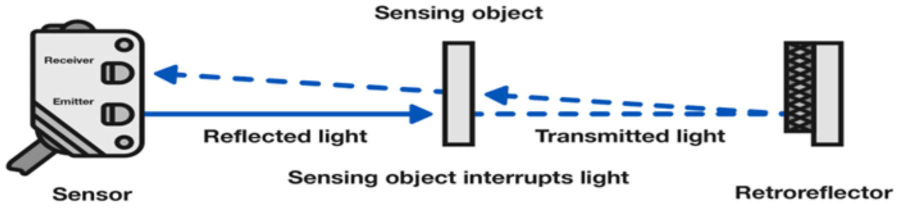


Fig (II.18): Retro Reflective Optical Sensors. [40]

II.2.3.2.3. Diffuse Optical Sensors:

The emitter and receiver of a reflecting photoelectric sensor are housed in the same enclosure. moment the light is emitted by the sensor the detecting object reflects light back to the receiver. The amount of light at the receiver changes as a result of this. This variation in light is utilized to generate electricity.

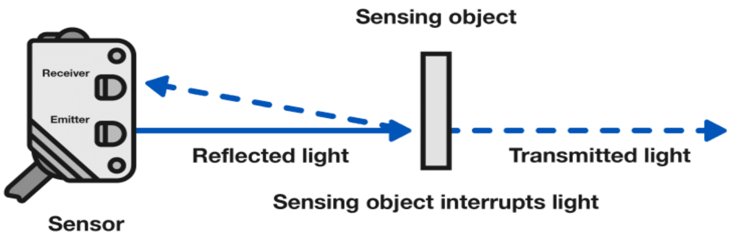


Fig (II.19): Diffuse Optical Sensors

II.2.3.3. Applications of Photoelectric Sensors across various Industries

- Food & Beverage Industry: Manufacturing and packaging lines in the food and beverage industries
- Automotive Industry: Photoelectric sensors used in the automotive industry have high precision that makes it possible for them to give accurate results even while operating around various objects with glossy surfaces.
- Machine Engineering: For big machines that need to be operated in perfect synchronization, photoelectric sensors can provide a good level of reliability.
- Doors & Gates: for example, on buses, trains, elevators, garages, etc.
- Material Handling: In storage facilities that have complete or semi-automation, photoelectric sensors make it possible to efficiently track objects in storage, help with automating the storing and stacking of goods, and helps maintain inventories.
- pharmaceutical industry: Pharmaceutical industry applications such as packaging of medicines also use photoelectric sensors.

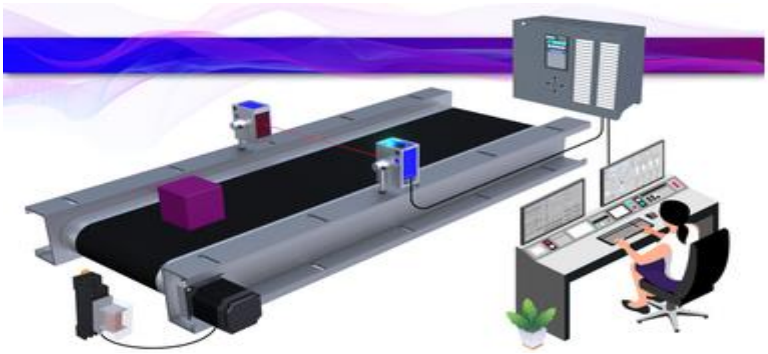


Fig (II.20): Applications of Photoelectric

II.2.4. Level Sensor point level measurement:

The level of material in a tank or silo is detected using point level sensors. There is a high level (the presence of material) and a low level (the absence of material) (absence of material).

A vessel can be filled to capacity while avoiding an overfill problem thanks to high level measurement. The facility is notified when a low level is detected.

II.2.4.1. Types of point level measurement

II.2.4.1.1. float switch Level Sensor:

A float switch is a device that detects the liquid level in a tank or container. As the liquid level rises or falls, it floats on top of the liquid surface and serves as a mechanical switch. [11]

II.2.4.1.1.1. Principle of work:

When a pump motor must start and stop in response to variations in the water (or other liquid) level in a tank or sump, a float switch is employed. Automated control of AC and DC pump motor magnetic starters, as well as automatic direct control of light motor loads, are provided by float switches.

- **Advantage**:
  - Non powered
  - Direct signal availability
  - Inexpensive
- **Disadvantage**
  - Have moving part
  - Invasive

Fig (II.21). Float switch. [41]

- **Applications of float level sensor**
- Tank level measurement
- It can be used to measure the level of water, oil, hydraulic fluids, and chemicals

II.2.4.1.2. Capacitance Level Sensor:

A capacitance level sensor is a proximity sensor that emits an electrical field and detects a level based on that field's effect. In liquid storage tanks, capacitance sensors can be used. A capacitance sensor would be suitable for a water treatment facility with storage tanks. [12]

Fig (II.22): Capacitance Level Sensor

II.2.4.1.2.1. Principle of work:

The change in capacitance is the basis for capacitive level measurement. One plate of the capacitor is an insulated electrode, and the other plate is the tank wall (or reference electrode in a non-metallic vessel). The capacitance varies according on the fluid level. The capacitance of an empty tank is lower, whereas the capacitance of a filled tank is larger. [13]

- **Advantage:**
  - Small
  - Less expensive
  - Accurate
  - No moving parts
- **Disadvantage:**
  - Invasive
  - Have to be celibrated
  - Detect certain liquids
- **Applications of capacitance level sensor**
  - Chemical
  - Food and brewery industries
  - Slurries
  - Liquids with solid particles
  - Corrosive materials like hydrofluoric acid

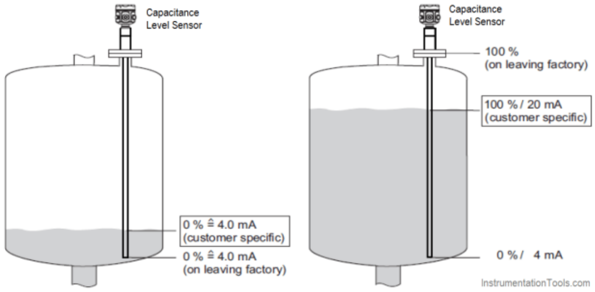


Fig. (II.23) : Capacitance level sensor

II.2.4.1.3. Optical level sensor

Optical sensors measure a physical quantity of light by converting light rays into electrical signals, which are subsequently translated into a measurement. [14]

Fig (II.24): Optical Level Sensor

II.2.4.1.3.1. Principle of work:

A photosensitive receiver and a near-infrared light emitting diode are included in the product. The light from the LED is focused through a prism on the sensor's top. When a liquid is immersed in the lens of a photoelectric level switch, light is refracted into the liquid, preventing or

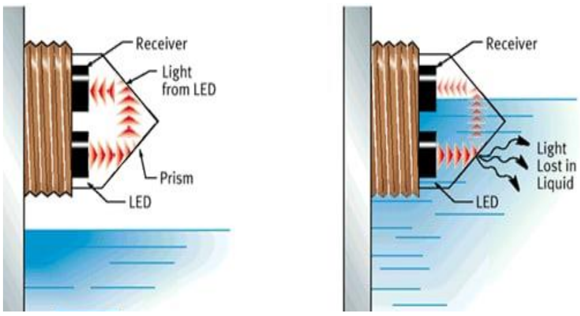


Fig (II.25): Optical level sensor

limiting the receiver's ability to receive
light. If there isn't any liquid available,

The light emitted by the light-emitting diode is immediately reflected from the lens back to the receiver, allowing the liquid level to be judged and an external alarm or control circuit to be activated. [15]

- **Advantage:**
  - The installation of these sensors does not involve moving parts
  - Not affected by high heat bikes and pressure
  - Small and lightweight
  - Immunity to electromagnetic interference
- **Disadvantage** :
  - Susceptible to interference from environmental effects
  - Can be costly
  - Susceptible to physical damage
- **Applications of optical level sensor**
  - Tank level measurement
  - It can be used for leak detection
  - It can be used to detect the level of liquids with suspended solid

II.2.4.1.4. Conductivity (resistance) level sensor:

A probe is used to read conductivity in a conductivity or resistance sensor. The probe has two electrodes to which alternating current is applied.

When the probe is submerged in liquid, the electrodes form a component of an electric circuit, producing current to flow and signaling a high or low level. [16]

Fig (II.26): Conductivity (resistance) level

II.2.4.1.4.1. Principle of work:

Differences in electrical resistance between the reference electrode and the level control electrode operate the conductive probes. When the level electrodes are submerged in the process fluid, these sensors detect the electrical resistance. The reference electrode can be an electrically conducting tank wall. An additional electrode is required as a reference if the tank is made of plastic, concrete, or any other nonconductive material. 2

- **Advantage:**
  - No moving parts
  - Easy to use
  - Low cost
- **Disadvantage**:
  - Nvasive (contact level measurement)
  - It can only be used with conductive liquids
  - The probe could erode during time
- **Applications of the conductive level sensor**
  - Level measurement of boiler water
  - It can be used with highly corrosive liquids
  - Reagent monitoring

II.2.4.1.5. Tuning (Fork) level sensor:

The vibrating fork level sensor operates on the idea of constantly vibrating a tuning fork sensor at its natural frequency and detecting changes in frequency and amplitude in the presence of application media. The type of application medium determines how parameters are monitored. [17]

Fig. (II.27): Tuning (Fork) level sensor. [42]

- Amplitude of vibration
- Frequency of operation

- **Advantage:**
  - Efficiency and small size
  - and ease of installation
  - She doesn't need maintenance
- **Disadvantage :**
  - It is high price
  - And her argument for touching a liquid surface
- **Application of Tuning fork level switch**
  - Pump control is based on the amount of water in the tank.
  - Automation at the wellhead (plunger lift, main line valve control, etc)
  - Fuel tanks for auxiliary generators

II.3. Analog Sensor

II.3.1. Definition:

Analog sensors are devices that exert a constant linear effort to modify their surroundings. Lighting and pressure sensing are common in PLC applications that require a precise unit of measurement. Analog inputs in PLC systems are typically 0-20MA, 4-20MA, or 0-10V. As a result, the sensor can be used as a current or voltage sensor. That's why the A/D ANALOGIQUE/DIGITAL adaptor was employed. [18]

II.3.2. Types of analog sensors:

II.3.2.1. Temperature sensor

There are two types of heat sensitivity in the industry:

II.3.2.1.1. Thermocouple

It's a link between two different metal alloys that results in electrical driving force when each alloy is exposed to a certain and varied amount of heat.

In 1821, Thomas Johan discovered that heat energy could be used to generate an electric current. [19]

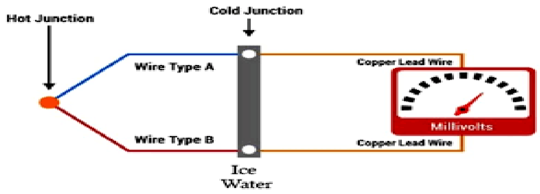


Fig (II.28) Principle of .Thermocouple

II.3.2.1.1.1. Principle of work:

When two distinct metals are connected and each is exposed to a different temperature, an electrical voltage is formed, and this voltage varies depending on the heat differences and substances.

Fig (II.29): Thermocouple sensor

- **Advantages :**

  - The advantages of thermocouples include the following.
  - It is Robust and can be used in environments like harsh as well as high vibration.

- The thermal reaction is fast
- The operating range of the temperature is wide.
- Wide operating temperature range
- Cost is low and extremely consistent

- **Disadvantage :**
  - Nonlinearity
  - Least stability
  - Low voltage
  - Reference is required
  - least sensitivity
  - The thermocouple recalibration is hard

- **Applications of thermocouples :**
  - These are used as the temperature sensors in thermostats in offices, homes, offices & businesses.
  - These are used in industries for monitoring temperatures of metals in iron, aluminum, and metal.
  - These are used in the food industry for cryogenic and Low-temperature applications. Thermocouples are used as heat pumps for performing thermoelectric cooling.
  - These are used to test temperature in chemical plants, petroleum plants.
  - These are used in gas machines for detecting the pilot flame.

II.3.2.1.2. Resistance thermometers

Meta with a high positive temperature coefficient makes up the sensing element. The Wheatstone bridge detects changes in resistance caused by temperature changes. The materials are chosen in such a way that the resistances R1, R2, R3, and R4 in the four arms of the bridge stay constant at room temperature. The galvanometer reads zero in this situation.

II.3.2.1.2.1. Principle of work:

The positive temperature coefficient concept governs the operation of a resistance thermometer. According to this theory, "electric resistance of metals is exactly proportional to temperature, i.e., electric resistance of metals increases as temperature rises." As a result, if we measure the electrical resistance of a wire made of any known material, we can determine its temperature. [19]

Fig (II.30): Resistance thermometer sensor

- **Advantages**
  - Wide operating ranges from -200°C to 1000°C.
  - Easy to install and replace.
  - Best suited for remote indication.
  - Better sensitivity.
  - Extremely accurate in sensing, measuring and displaying the temperature measured.
  - Stability of performance over a long period of time.
  - Linear Resistance-Temperature relationship.
- **Disadvantages**
  - High cost.
  - Needs bridge circuit with power supply.
  - Possibility of self-heating.
  - Large bulb size required for measuring high temperatures.
  - Sometimes, balancing of bridge takes more time.
- **Applications of Resistance Thermometer**
  - Temperature measurement in heat ng ovens, drying ovens, pressure vessels, baths etc.
  - Temperature measurement of cold storage plant, boiler and power generator etc.
  - For measurement of radiant heat.
  - Food processing plants.
  - Temperature measurement of exhaust gases.
  - Petrochemical industries.
  - Refrigeration and Air-conditioning applications.
  - Process industries.

II.3.2.2. pressure sensor

II.3.2.2.1. Pressure transmitter sensors

A pressure transmitter is a mechanical device that converts a liquid or gas sample's expansion force into an electrical output. A transducer turns the pressure into an electrical signal in the gadget. Depending on the composition of the analyte, this sort of sensor, also known as a pressure transducer, usually consists of a pressure sensitive surface area consisting of steel, silicon, or other materials. Electronic components are hidden underneath these surfaces, capable of turning the force exerted on the pressure sensor by the sample into an electrical signal. [20]

Fig (II.31): pressure transmitter sensors. [43]

II.3.2.2.1.1. Principle of work:

A pressure transmitter, in general, is made up of three parts: a pressure sensor, a measuring circuit, and a process connection. The pressure transmitter's principal job is to transform the physical properties of the gas, liquid, and other physical properties of the pressure sensor into a standard electrical signal. For indicating the alarm device, the adjusting device, the recorder, and the secondary instrument, the standard electrical signal is more convenient. The capacitive pressure transmitters of the measuring medium are split into high-voltage and low-pressure chambers, and the liquid-filled isolation and components are transported to the sides of the membrane for measurement on the isolating diaphragms on both sides of the sensitive element. When the pressures on both sides are inconsistent, the diaphragm's displacement, as well as the displacement and pressure differential, are proportional to the capacitance range's two sides. The pressure is turned into a signal by the oscillation and demodulation processes. In contrast to the pressure chamber pressure of a pressure chamber, the working principle of a capacitive pressure transmitter is similar to that of a differential pressure transmitter. The capacitive pressure transmitter's A/D converter turns the demodulator's current into a digital signal and utilizes the microprocessor's value to calculate the input pressure value. [21]

- **Advantages**

- It can be run over long distances with minimal signal losses compared to voltage type signals
- A varying current loop load impedance or supply voltage will not significantly affect the signal as long as it does not exceed recommended component limits
- Rugged signal with low electromagnetic susceptibility
- Saves on cable wire because it only needs 2 wires to function
- Live zero reading verifies sensor is electrically functional

- **Disadvantages**
  - High power consumption compared to other analogue signal types
  - Elevated output at zero reading
  - Supply not isolated from output
  - Increasing circuit load resistance, will reduce the supply voltage available to power the transmitter that is generating the 4-20mA signal.
- **Applications**
  - Calibration technology
  - High-accuracy pressure monitoring
  - Pressure sensing in critical applications
  - Process instrumentation.

II.3.2.3. Level sensor (height)

Continuous level sensors are used to measure levels to a degree, although they don't always give correct findings. Wireless data transfer to the surveillance system is used in current technologies, which is useful in high and dangerous regions that are difficult to access by ordinary personnel. [22]

II.3.2.3.1. Continuous Level Measurement Sensors:

1- Hydrostatic
2- Advanced

II.3.2.3.1.1. Hydrostatic

II.3.2.3.1.1.1. Principle of work:

It is a sensation that calculates the differential difference in liquid height by pressing from the top and bottom of the tank. [23]

Fig (II.32): differential pressure sensor hydrostatic. [45]

II.3.2.3.1.2. Advanced

It's a form of sensor that uses a radar and a wave transmitter and receiver, however the type of wave employed varies.

- **And this type has 2 types:**
  - Ultrasonic sensor
  - Radar sensor

II.3.2.3.1.2.1. Ultrasonic sensor

II.3.2.3.1.2.1.1. Principle of work:

Ultrasound sensors send and receive ultrasound, and the liquid level is determined by calculating the time it takes for ultrasound to reflect off the liquid's surface. [24]

Fig (II.33): Ultrasonic sensor.

- **Advantages**

  The transducer does not come into contact with the process material, it has no moving parts, and there is just one top of vessel entry, which decreases the likelihood of leaks when compared to fully wetted systems.

- **Disadvantages**

  A number of factors influence the return signal. Powders, heavy vapors, surface turbulence, foam, and even background noise can all affect the signal returned. Temperature can be a limiting factor in many process applications. Ultrasonic devices will not work in a vacuum or under high pressure.

- **Applications**

  - Loop control

- Roll diameter, tension control, winding and unwind
- Liquid level control
- Thread or wire break detection
- Robotic sensing
- Stacking height control
- 45° Deflection; inkwell level detection; hard to get at places
- People detection for counting
- Contouring or profiling using ultrasonic systems
- Vehicle detection for car wash and automotive assembly

II.3.2.3.1.2.2. Radar sensor

II.3.2.3.1.2.2.1. Principle of work:

The first type of radar sensor employs microwave waves, which include light and electromagnetic waves, and has a high frequency of 0 giga hertz to 21 giga hertz[25] .

And it's worth noting that these waves aren't impacted by gases, heat, pressure, or anything else. The dimensions of the tank, the speed of the wave, the time it takes to go and return are all taken into account when making this type of sensor, and the second type of radar sensor, known as (TDR Guided wave radar), works in the same way as the previous sensor, but it works by touching and uses microwave waves with a frequency of 1.5 g Hertz.

This type is employed when there is a proportion of noise and interference from the nozzle, as well as liquids with foam that need to be precise to within 2mm.

Fig (II.34): Radar (microwave) level measurement. [46]

- Radar or microwave is also a continuous level sensor.

An antenna on the radar sensor transmits microwaves from these sensors. The product being sensed reflects these microwaves back to the antenna, and the time between signal emission and reception is proportional to the product's level. [26]

- **Advantages**
  - They are not affected by temperature, pressure or dust
  - They can also measure liquids, pastes, powders, and solids
  - They are very accurate and require no calibration
  - They are non-invasive because they do not have to touch the product that it is sensing
- **disadvantages**
  - They are expensive
  - They have a limited detection range
- **Applications**
  - disturbing objects close to the probe.
  - media with higher dielectric constant gives a better reflection and allows a longer measuring range.
  - surface foam and particles in the tank atmosphere may affect measuring performance.
  - heavy coating or contamination on the probe should be avoided since it can reduce the measuring range and might cause erroneous level readings.

II.3.2.3. Flow sensor

II.3.2.3.1. Ultrasonic flow meter

II.3.2.3.1.1. Definition:

A meter that uses ultrasound to measure liquid velocity in order to assess the volume of liquid flow is known as an ultrasonic flow meter. This is a volumetric flow meter that requires the presence of bubbles or minute particles in the liquid flow. These meters are suited for wastewater applications, but not for drinking or distillation water. As a result, this type of flow meter is appropriate for applications requiring chemical compatibility, low maintenance, and minimal pressure loss. [27]

These meters will have an impact on the liquid's acoustic qualities, as well as viscosity, density, temperature, and other factors. These meters, like mechanical flow meters, have no moving parts.

Because the price of these meters fluctuates so much, they can be utilized and maintained at a minimal cost.

Fig (II.35): Ultrasonic flow sensor. [47]

II.3.2.3.1.2. Principle of work:

Upstream and downstream transducers, sensor pipe, and reflector can all be used to build an ultrasonic flow meter. The ultrasonic flow meter works on the principle of using sound waves to resolve the velocity of a liquid within a conduit. In the pipe, there are two states: no flow and flowing. The frequencies of ultrasonic waves are transferred into a pipe in the first condition, and the indication from the fluid is comparable. Because of the Doppler Effect, the frequency of the reflected wave is different in the second case. [28]

When liquid flows swiftly through the pipe, the frequency shift can be increased linearly. The wave's signals are processed by the transmitter, and the flow rate is determined by the reflections. Within the pipe, transit time meters broadcast and receive ultrasonic waves in both directions. When there is no flow, the time it takes for water to flow upstream and downstream between the transducers is the same.

Under these two flowing conditions, the wave at upstream will flow with less speed than the downstream wave. The difference between upstream and downstream timings grows as the liquid flows faster. The flow rate is determined by the transmitter's processing of the upstream and downstream times.

Because of the Doppler Effect, frequency is different. [28]

II.3.2.3.1.3. Types of Ultrasonic Flow Meter:

1) Doppler velocity type meters use reproduced ultrasonic noise to calculate the liquid's velocity.

2) Radar type meter employs microwave technology for transmitting small pulses to reflect off a flowing surface back to the sensor for deciding velocity.
3) Ultrasonic clamp-on type meter is ideal for applications wherever accessing the pipe is difficult otherwise not possible.
4) Ultrasonic level type meter is ideal for determining the fluid level in both open closed channels.

- **Advantages**
  - It does not block the path of liquid flow.
  - The o/p of this meter is different for density, viscosity & temperature of the liquid.
  - The flow of liquid is bidirectional
  - The dynamic response of this meter is good.
  - The output of this meter is in analog form
  - Conservation of energy
  - It is appropriate for huge quality flow measurement
  - It is handy to fit and maintain
  - Versatility is good
  - There is no contact to liquid
  - There is no leakage risk
  - There are no moving parts, pressure loss
  - High accuracy

- **Disadvantages**
  - It is expensive as compared with other mechanical flow meters.
  - Design of this meter is complex
  - Auditory parts of this meter are expensive.
  - These meters are complicated as compared with other meters, thus it requires specialists for maintaining and repairing these meters
  - It cannot measure cement or concrete pipes one they rusted.
  - It doesn’t work once the pipe contains holes or bubbles in it
  - Can’t measure cement/concrete pipe or pipe with such material lining

- **Applications**
  - These meters are used in wastewater and dirty liquid applications
  - These meters are used wherever chemical compatibility, less maintenance, and low-pressure drop are required.

- These meters are used to measure the velocity of a liquid through ultrasound to analyze volume flow.
- These meters measure the disparity between the transit time of ultrasonic pulses which transmits with the direction of liquid flow
- The applications of these meters range from process to custody flow
- This is one kind of device for volumetric flow measurement for liquids as well as gases.
- These are excellent alternatives for both vortex & electromagnetic flow meters.

II.4. Conclusion:

This chapter gave an overview of sensors, including their fundamentals, characteristics, and many varieties. A sensor is a device that receives a signal and converts it to an electric signal. These sensors are categorized according to their applications, cost, and range. This chapter provides an overview of sensors, including basic information, attributes, accuracy, and range. Thermal, electrical, optical, and mechanical magnetic sensors are among the many types of sensors available. Technology has progressed to the point where cognitive and intelligent sensors are now utilised in all modern applications.

As we saw in this chapter, we assigned to each sensitive how many positives and negatives it has, as well as how much it is used on the ground, and we must conclude from carefully studying the chapter that we must employ economic sensors for a price that has more positives than negatives.

Chapter (III)
PLC contribution applications to Industrial control

III.1. Introduction

We researched and studied the field of "PLC" programmable logical control, which is one of the most important industrial magazines, and the goal of this work is to understand and know how to contribute programmable automatic control in the industry, and we researched projects suitable for me to understand this field, so we found an industrial simulator, factory io, so that we can do simulations and programming industrial business, and the goal of this work is to understand and know how to contribute programmable automatic control in the industry, and we researched

III.2. Explaining the factory I/O program

Factory I/O is a 3D factory simulation for learning automation technologies. Designed to be easy to use, it allows to quickly build a virtual factory using a selection of common industrial parts. Factory I/O also includes many scenes inspired by typical industrial applications, ranging from beginner to advanced difficulty levels.

The most common scenario is to use Factory I/O as a PLC training platform since PLC are the most common controllers found in industrial applications. However, it can also be used with microcontrollers, SoftPLC, Modbus, among many other technologies.

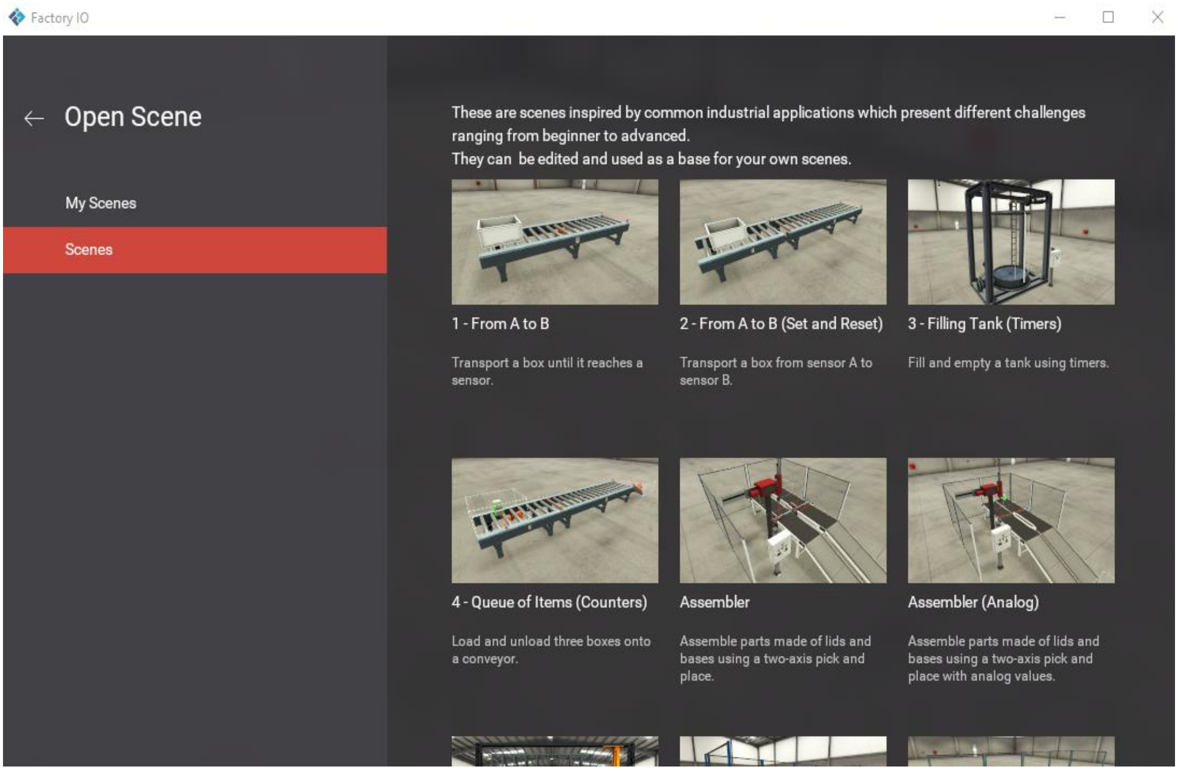


Fig. (III.1) : Factory I/O

- Two projects have been selected from the factory program.
  - Project one : Level Control

Control the level of liquid (or flow) of the tank using sensors

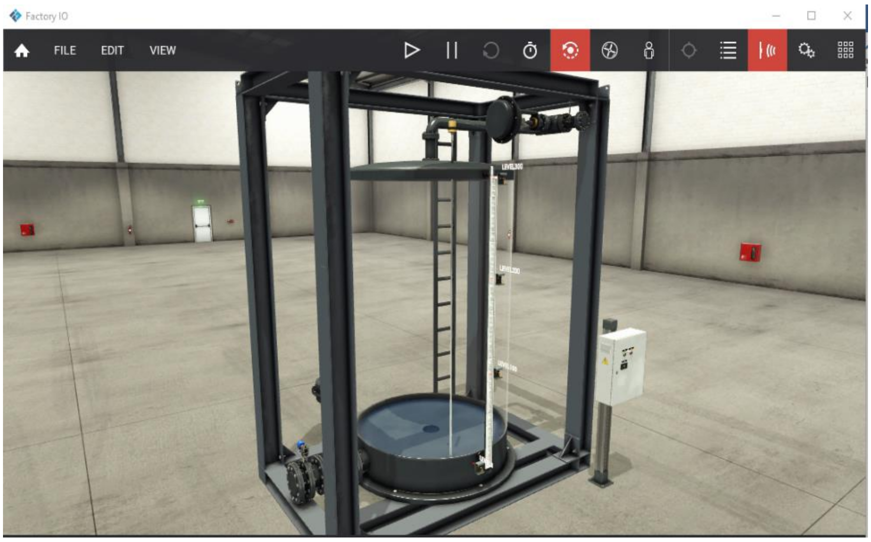


Fig. (III.2): Level Control

  - Project two: Palletize cases in several layers.

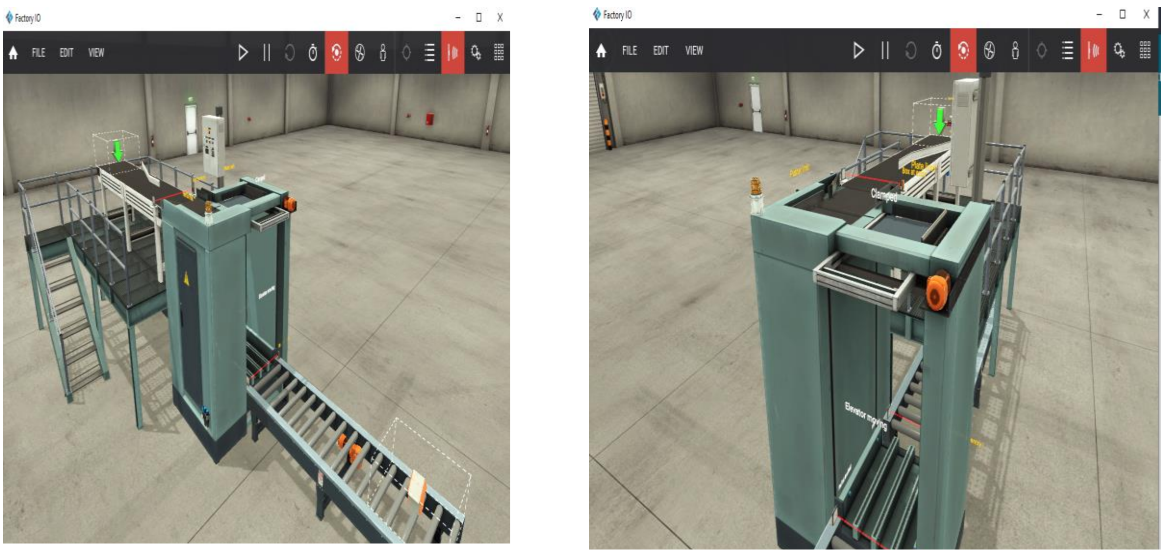


Fig. (III.3): Palletize cases in several layers.

III.3. The type of logical controller is programmable used in this project

The plc type used is from the Siemens S7 200 family.

The S7-200 series of micro-programmable logic controllers (Micro PLCs) can control a wide variety of devices to support your automation needs. The S7-200 monitors inputs and changes outputs as controlled by the user program, which may include Boolean logic, counting, timing, complex math operations, and communications with other intelligent devices. The compact design, flexible configuration, and powerful instruction set combined to make the S7-200 a perfect solution for controlling a wide variety of applications.

Fig. (III.4): PLC S7 200

- SIEMENS STEP 7-Micro/WIN programming software allows the user to modify the program while running it. [44]
- Source of nutrition 24 volts DC

III.4. Programming software STEP 7-Micro/WIN

Siemens makes it, and it lets users to install software on it. There's quite a bit of it. You may control all kinds of features and instructions used in the creation of PLC programs in a unit S7 200. Learn how to use the Micro/Win software interface.

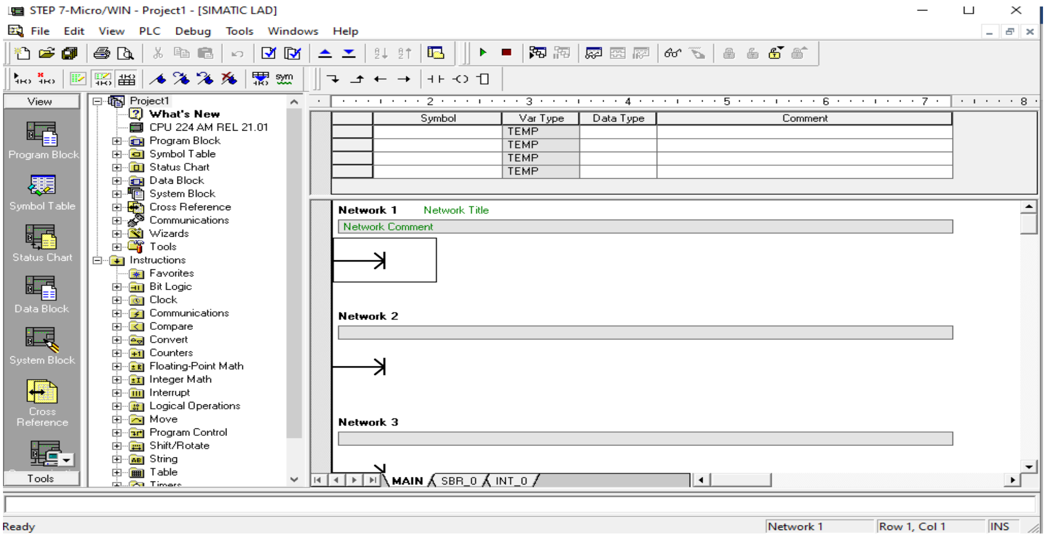


Fig. (III.5): Programming software STEP 7-Micro/WIN

The program consists of a set of lists and three main parts

- **Main menu bar**

  It contains all the lists through which the program can be controlled as well as the PLC unit

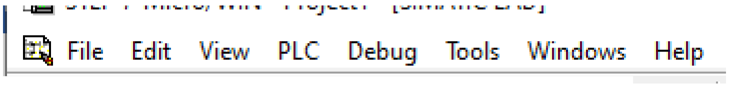


Fig. (III.6) : Main menu

- **Standard toolba**

And it has the tools that the user constantly uses

Fig. (III.7) : Standard toolba

- **Debug toolbar**

It contains error identification tools in the program as well as a program inspection as a whole to make sure There's no mistakes in it.

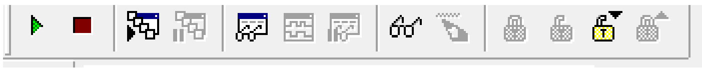


Fig. (III.8) : Debug toolbar

- **Instruction toolbar**

  It contains programming elements that are constantly used to create the program

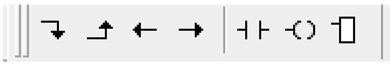


Fig. (III.9): Instruction toolbar

- For the three parts of the micron progra

- **One: Navigation bar**

One of the most important elements that it contains and constantly uses in the program

- Program block: This is the environment in which the user program is created

- Symbol table: Input/output addresses are described with appropriate comments written for each title
- Communications: Allows the connection between PLC and PC to be modified

- Set PG / PC interface: The type of communication cable used in the PC-PLC connection process is defined

- **Two: instruction tree**

It contains all programming orders used to build the program.

- **Three: program editor**

It is a work or programming environment and is divided into a net network group

III.5. Language programming used at work

We relied on programming our project on the language of the Ladder diagram (LAD)

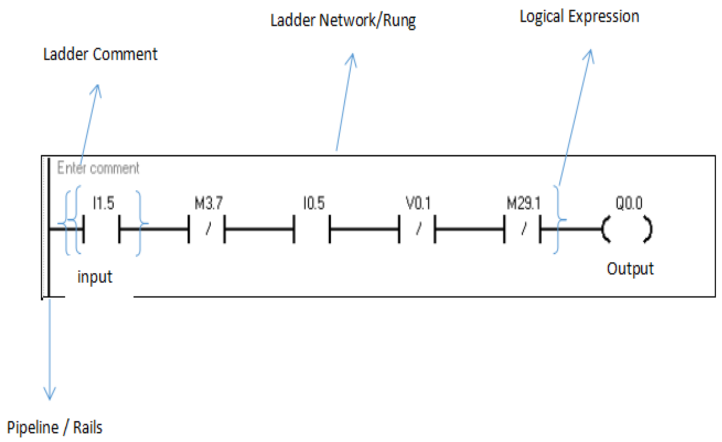


Fig. (III.10) : Ladder diagram (LAD)

The Peace Logic Scheme is a graphical or symbolic representation of a diagram of industrial automation logical control circuits. The logical plans for peace combine two vertical power rods with a horizontal logical grid to create a ladder-like structure. The networks in a ladder diagram contain control logic. Rung is a type of PLC network used in a few PLC networks. One score contains all the string and parallel logic

III.6. Connecting the communication cable

USB PC/PPI user connection cable type

Fig. (III.11): PC/PPI cable

III.6.1. Steps to set up the connection between PC and PLC

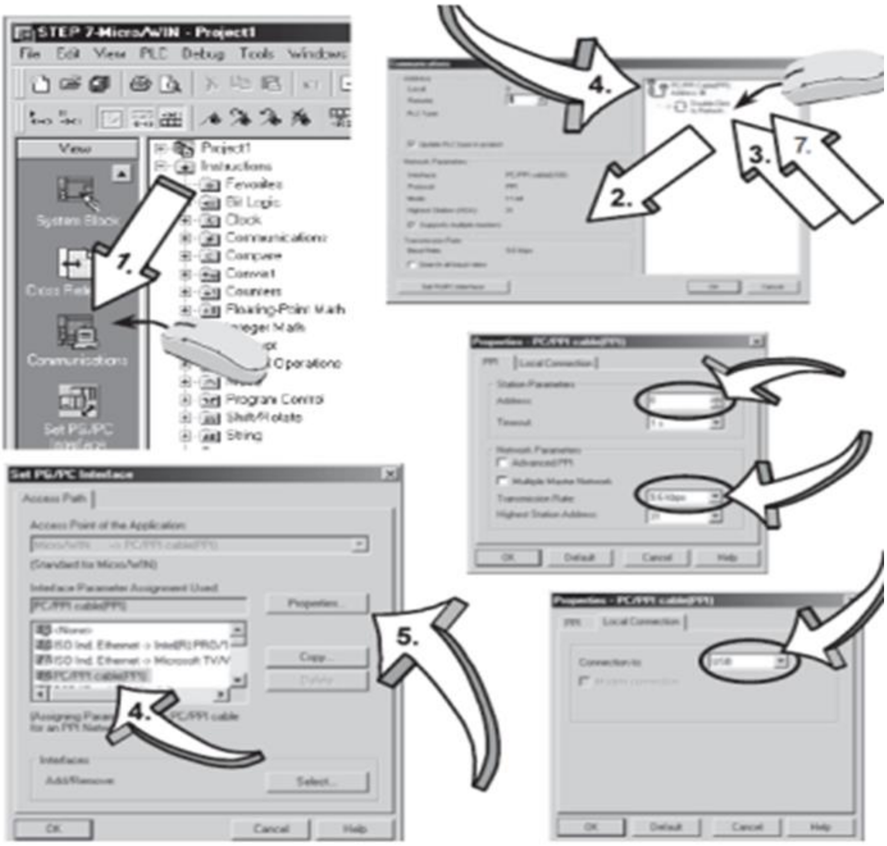


Fig. (III.12): Explain how to connect

III.7. Final installation phase

As we said before, we're going to program two projects from factory.

III.7.1. Project one: Level Control

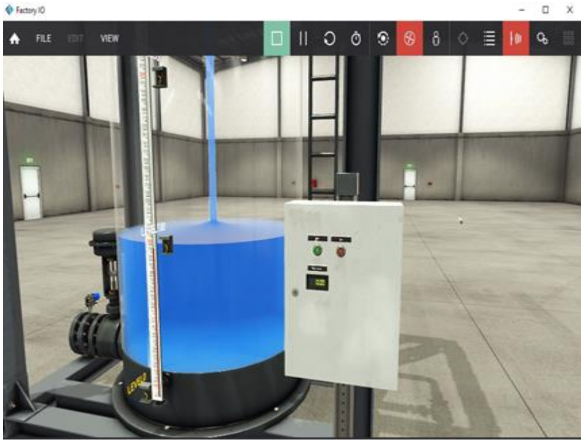


Fig. (III.13): Fill-up and unloading

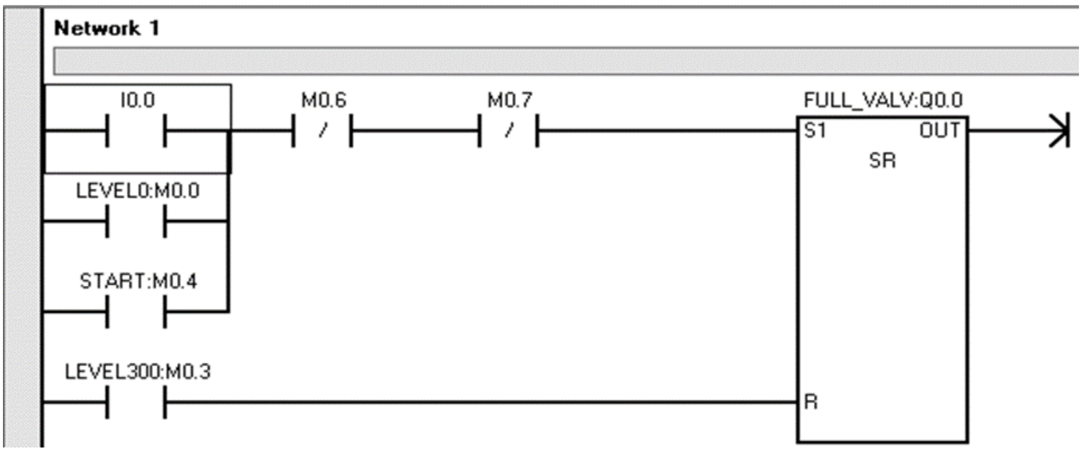
Explanation with the program :

			Symbol	Address
1			FULL_VALV	Q0.0
2			DISCHVALV	Q0.1
3			LEVEL0	M0.0
4			LEVEL100	M0.1
5			LEVEL200	M0.2
6			LEVEL300	M0.3
7			START	M0.4
8			STOP1	M0.5
9			Digital_Display_1	VB0

Fig. (III.14): Symbol Table Project one

- ✓ **Network1**

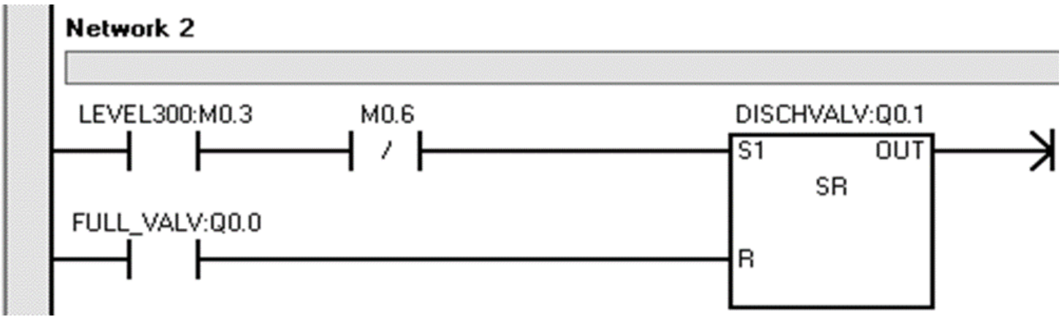
By clicking on I0.0, "FULLVALV Q0.0" works



- ✓ **Network2**

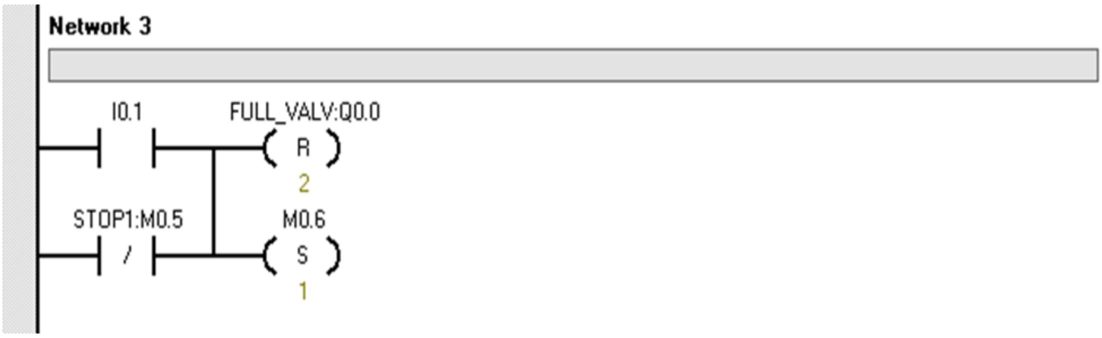
When the liquid level reaches "LEVEL300 M0.3", "Dischvalv Q0.1" runs at the same moment "fullvalv Q0.0" stops.

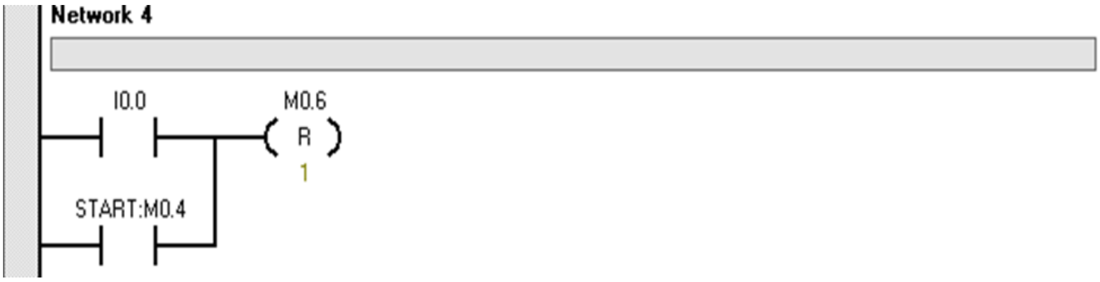
When the liquid reaches the "LEVL100 M0.1" sensor, "Fullvalv Q0.0" is turned on, remaining. This is a constante situation.

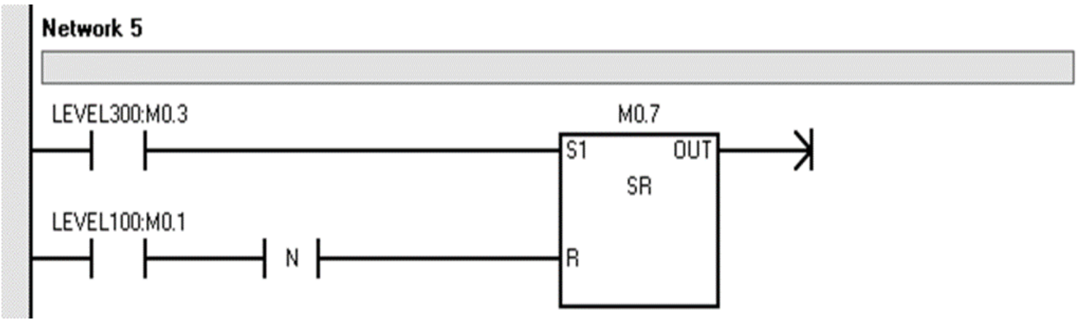


- ✓ **Network3**

When "Stop I0.1" is pressed the system is stopped







III.7.2. Project two: Palletize cases in several layers.

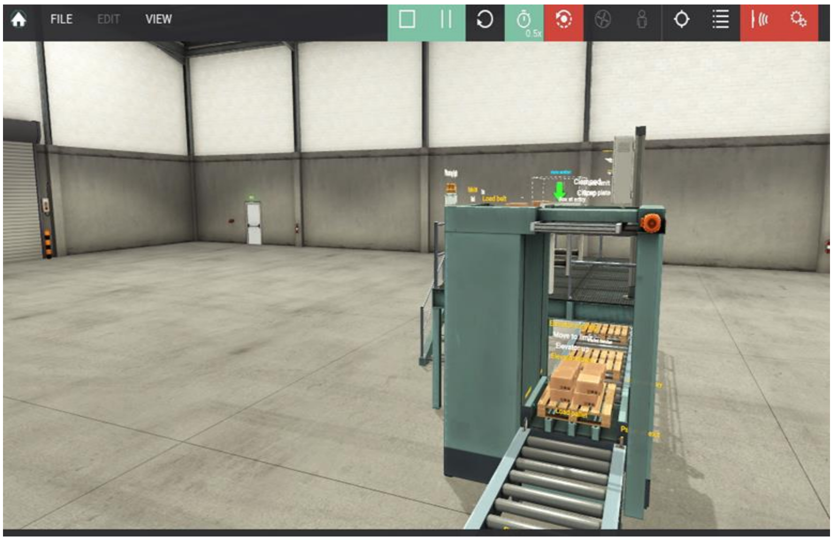


Fig. (III.15): Palletize cases in several layers.

- Explanation with the program :

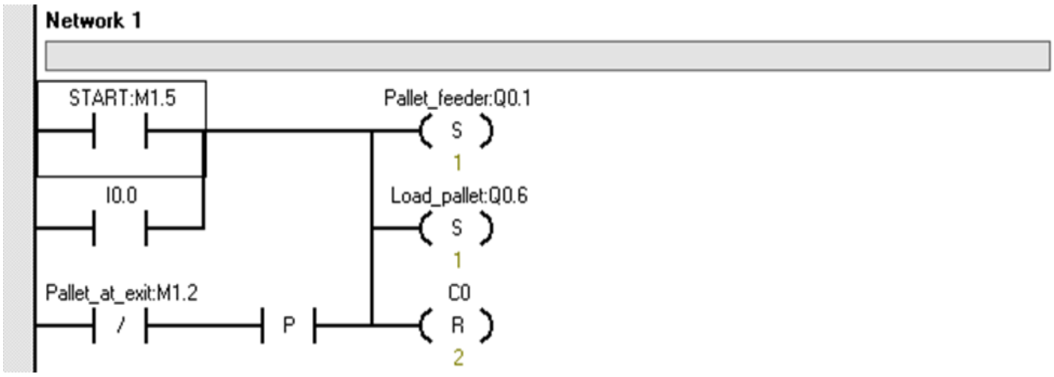
			Symbol	Address
1			Elevator_moving	M0.5
2			Box_feeder	Q0.0
3			Move_to_limit	M0.4
4			Load_belt	Q0.2
5			Elevator_up	Q0.3
6			Box_at_entry	M0.0
7			RRR	M0.3
8			Push	Q0.4
9			Pusher_limit	M0.6
10			Pallet_feeder	Q0.1
11			Load_pallet	Q0.6
12			Emergency_stop	M1.4
13			Pallet_at_entry	M0.1
14			Plate_limit	M0.7
15			Open_plate	Q0.7
16			Clamp	Q1.0
17			Clamped	M1.0
18			Elevator_down	Q1.1
19			STOP1	M1.6
20			Pallet_at_exit	M1.2
21			Exit_conveyor	M1.3
22			START	M1.5

Fig. (III.16): Symbol Table Project two.

- ✓ **Network1**

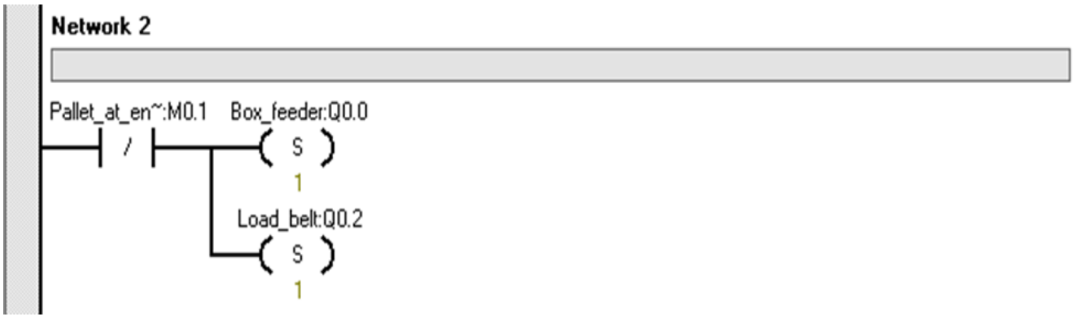
When you press the I0.0 key run.

"Pallet feeder Q0.1" and Load pallet Q0.6" are turned on in order to move the box holder to the lifter.



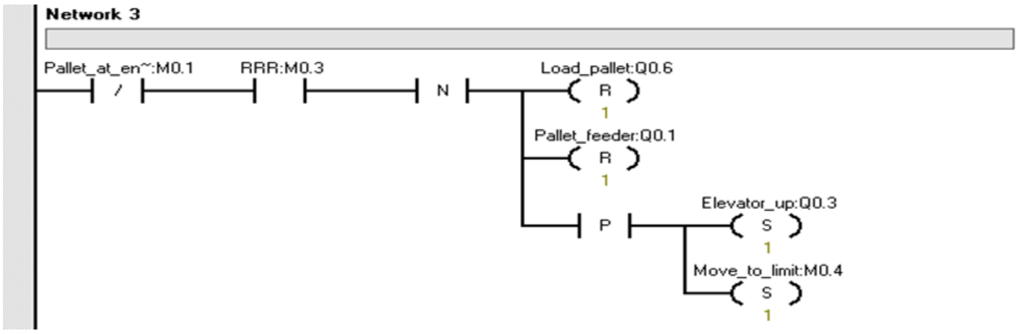
- ✓ **Network2**

When the "Pallet at entry M0.1" sensor is activated, it runs "Box feeder Q0.0" and "Load belt Q0.2" to produce boxes.



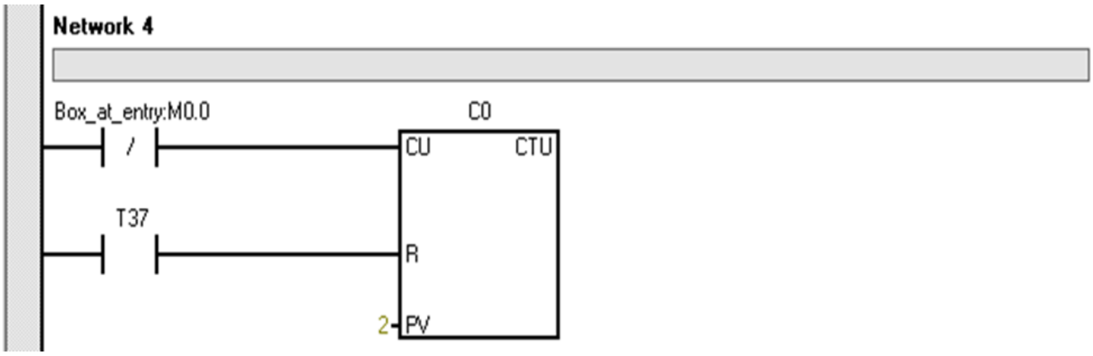
- ✓ **Network3**

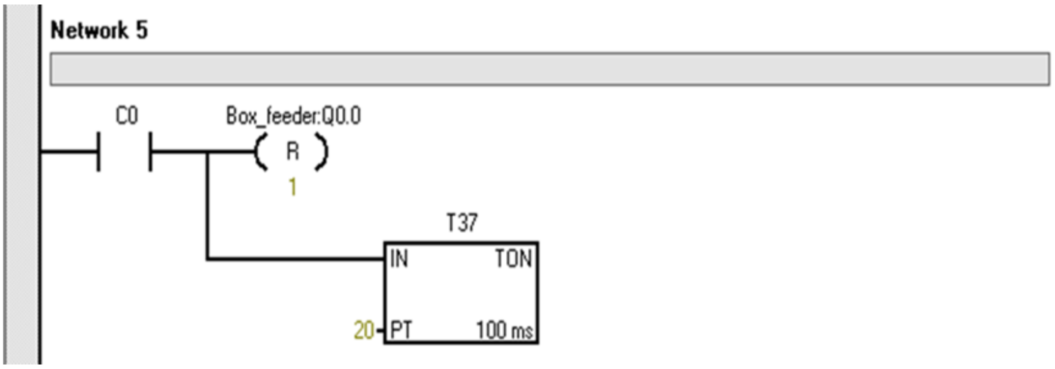
When the "Pallet at entry M0.1" sensor is activated," Load pallet Q0.6" and " Pallet feeder Q0.1" are stopped, and "Elevator up Q0.3" and "Move to limit M0.4" are also turned on.



✓ **Network4**

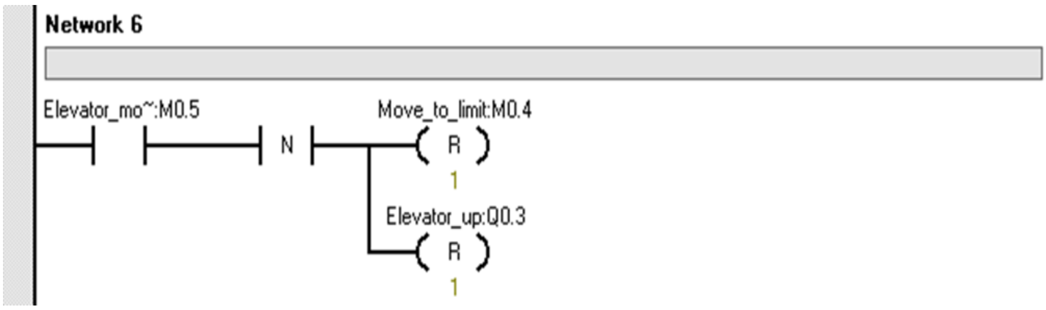
When the "Box at entry M0.0" sensor works, the C0 counter starts to count upwards and after two separate signals, it changes the open points, the "Box feeder Q0.0"stops and the timer T37 starts working. Which is in **Network 5**





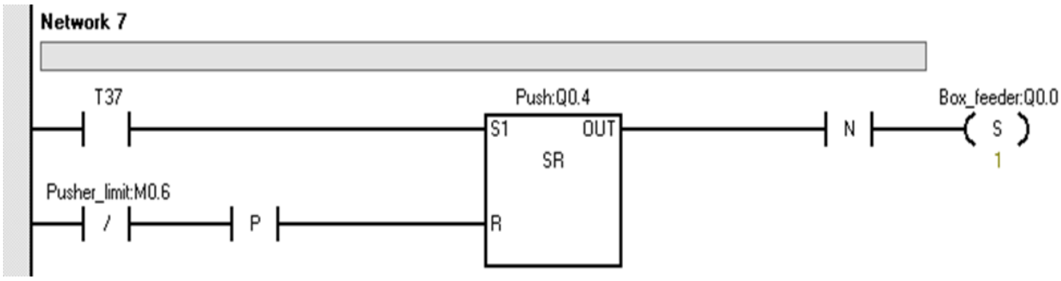
✓ **Network6**

When the "Elevator moving M0.5" entry key is activated, both "Move to limit M0.4" and "Elevator up Q0.3" are stopped.



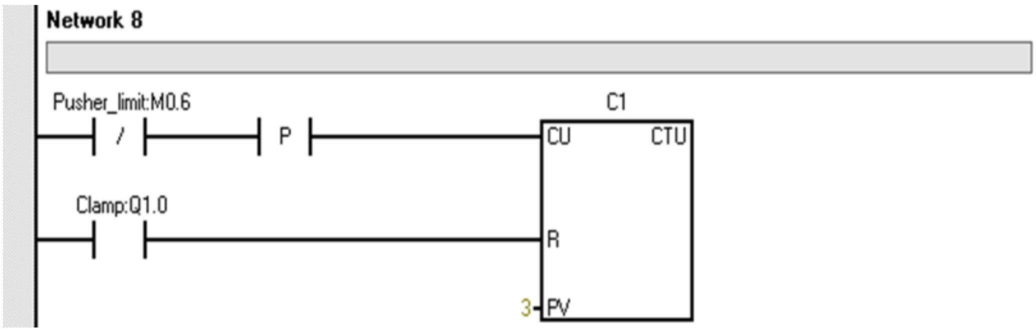
✓ **Network7**

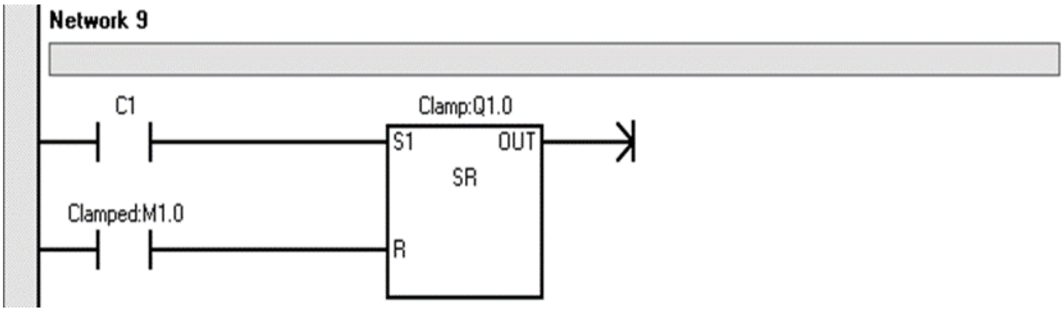
When open points change to T37 timer after two seconds, "Box feeder Q0.0" and Q0.4 exits are turned on.



✓ **Network8**

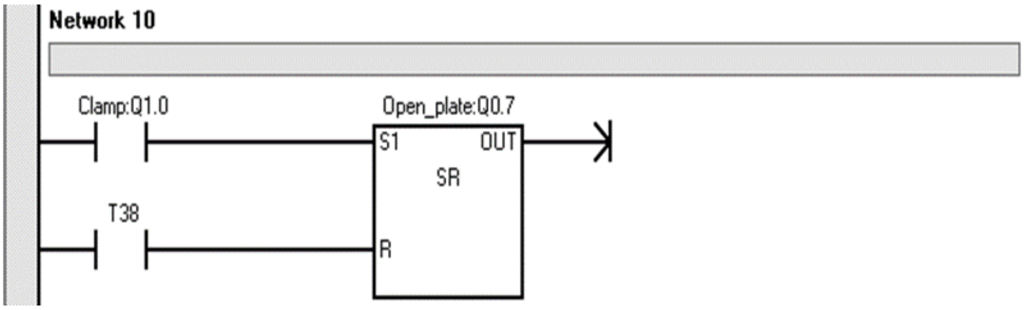
When the "Pusher limit M0.6" open point changes, the C1 counter starts to count upwards after 3 scattered signals, changes the open points and stops the "Push Q0.4" output and runs out "Clamp Q1.0", which is in **Network9**





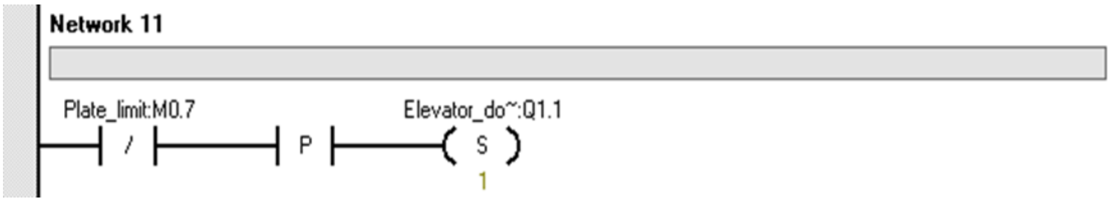
- ✓ **Network10**

The "Clamp Q1.0" output changes the open points to run the "Open plate Q0.7" output and stop the "Clamp Q1.0" output



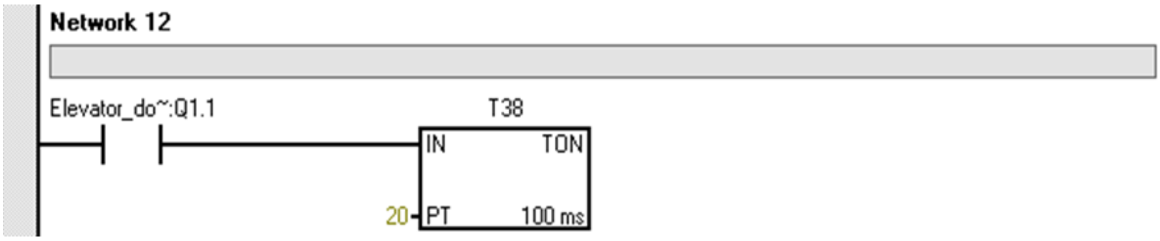
- ✓ **Network11**

The "Plate limit M0.7" key changes the open points to turn on the "Elevator down Q1.1" output.



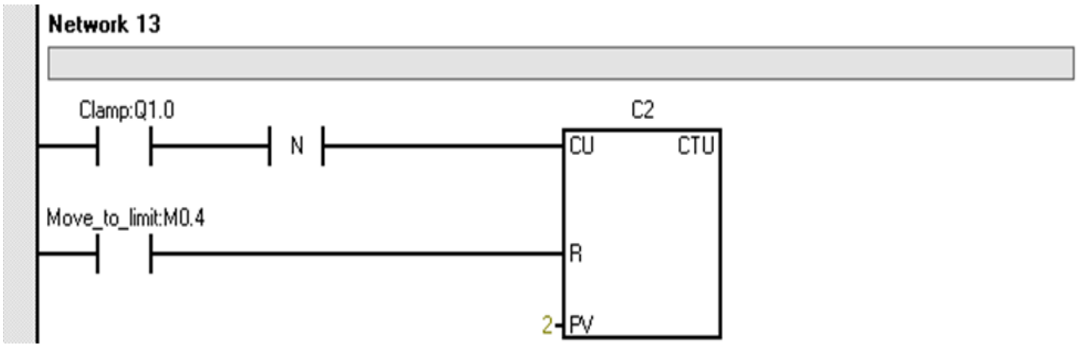
- ✓ **Network12**

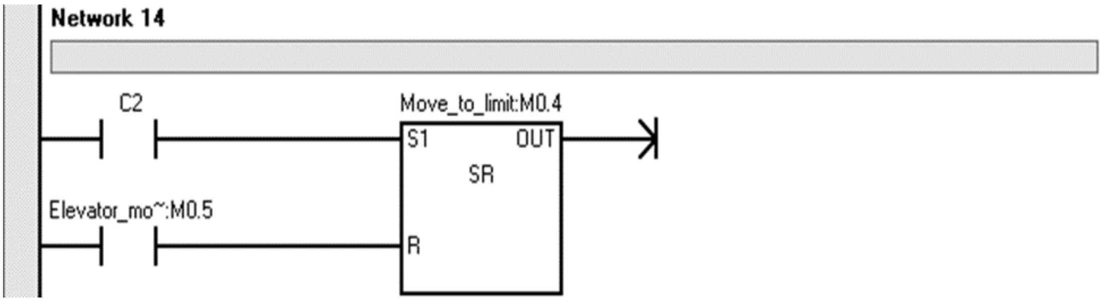
The "Elevator down Q1.1" output changes the open points to run the T38 timer after 2 seconds, the open points of the T38 are changed to stop the "Open plate Q0.7" output.



- ✓ **Network13**

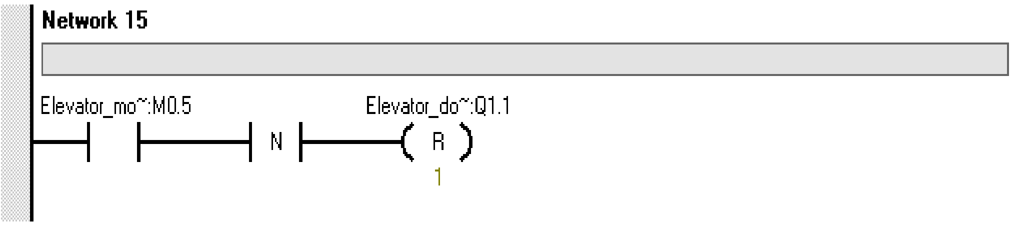
The "Clamp Q1.0" exit changes the open points, the C2 counter begins to count upwards after two separate signals, so the open points are set to run the "Move to limit M0.4" output, which is in **Netwrok14**





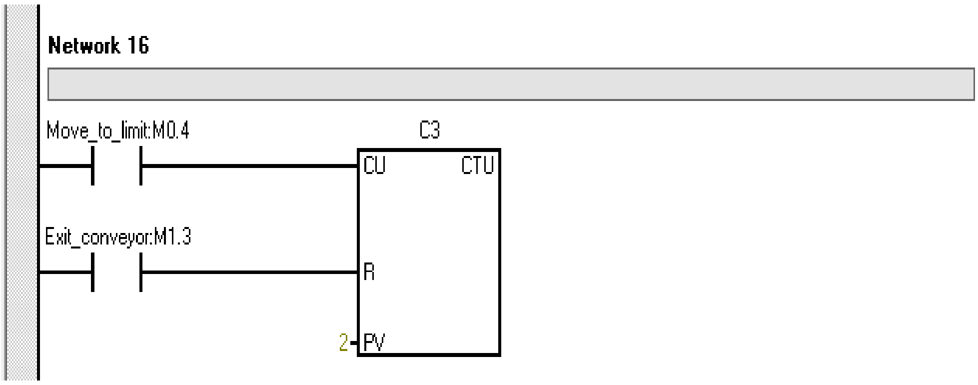
- ✓ **Network15**

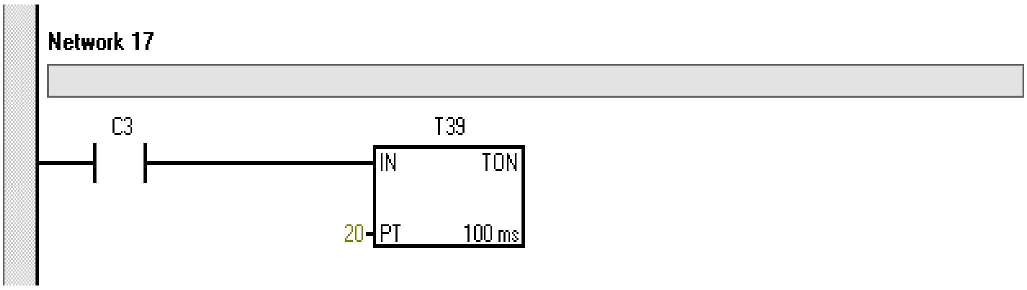
When "Elevator moving M0.5" changes open points, it stops both output "Elevator down Q1.1" and "Move to limit M0.4".



- ✓ **Network16**

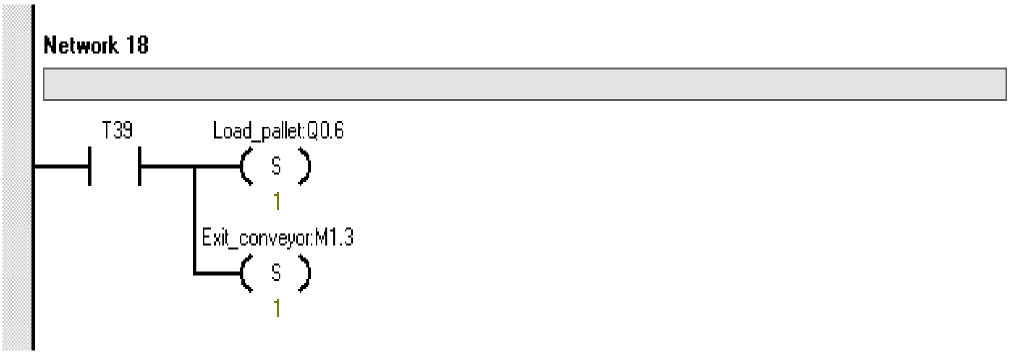
When the "Move to limit M0.4"exit changes the open points, the C3 counter begins to count upwards after two separate signals, and the open points change, to run the T39 timer that is in **Network**17





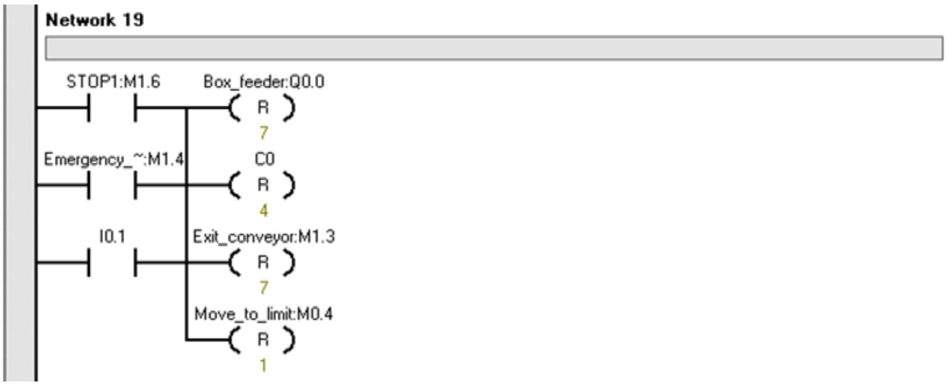
✓ **Network18**

When the T39 timer changes its state after two seconds, it changes the output "Pusher limit Q0.6" and "Exit conveyor M1.3".



✓ **Network19**

When "Stop I0.1" is pressed, the system is shut down



III.8. Conclusion:

In this chapter, we used the SIEMENS STEP 7-Micro/WIN programming industrially programmable logical controller to program two examples of the "Factory i/o" Emulator application.

General conclusion

General conclusion

In our dissertation, we conducted a comprehensive study on the logical console, where we learned about its types, programming methods and areas of use.

So we conducted a study on applying how to control plc's function in the industry Because of the existence of a specific program like Factory I/O, which helped us a lot in simulating a computer factory, which made the factory in our hands and in our service, which made this a lot easier for us to study as we used ladder programming language in this study.

We have connected the entrances and exits of our PLC controller to the necessary feed. We have connected the PC/PPI cable to PLC. Then we made factory I/O read the PLC unit and the rest shown in chapter three.

The study we've created is scalable thanks to the testing program, which enables us to avoid mistakes that can actually happen and cause losses.

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Résume :

Les tribunaux programmables ont considérablement amélioré la facilité avec laquelle divers systèmes de contrôle industriel peuvent être mis en œuvre.

Ce dernier offre aux utilisateurs un certain nombre d'avantages, notamment une réduction du temps et des efforts. Nous avons utilisé le contrôleur intelligent Siemens S7 200 dans cette communication et l'avons connecté à des exemples industriels de programmation de simulateurs d'usine, ce qui est simple à comprendre pour nous.

Mots clés : Automate Programmable Industriel (API)

Abstract:

Programmable tribunals have made a significant improvement in the ease with which various industrial control systems can be implemented.

The latter provides users with a number of advantages, including a reduction in time and effort. We used the Siemens S7 200 smart controller in this communication and connected it to factory simulator programming industrial examples, which is simple for us to understand.

Keywords : Programmable Logic Controllers (PLC)

ملخص:

وقد حققت المحاكم القابلة للبرمجة تحسنا كبيرا في السهولة التي يمكن بها تنفيذ مختلف نظم الرقابة الصناعية.

يوفر هذا الأخير للمستخدمين عددا من المزايا ، بما في ذلك تقليل الوقت والجهد. استخدمنا وحدة التحكم الذكية Siemens S7 200 في هذا الاتصال وقمنا بتوصيلها بمحاكاة المصنع برمجة الأمثلة الصناعية ، وهو أمر بسيط بالنسبة لنا لفهمه.

الكلمات المفتاحية: وحدة التحكم المنطقية القابلة للبرمجة الصناعية PLC