معهد التكنولوجيا التطبيقية

INSTITUTE OF APPLIED TECHNOLOGY

PLC

Module 1: Introduction to PLC

PREPARED BY

IAT Curriculum Unit

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Module Objectives

Upon successful completion of this module, students will be:

1. able to demonstrate knowledge of control systems.
2. familiar with the concept of manual and automatic control.
3. familiar with the basics of PLC, its function, advantages, applications and the manufacturers.
4. identify the main parts of the Siemens LOGO! PLC Module.
5. capable of programming the Siemens LOGO! PLC Module through its Basic Control Unit using simple commands.
6. Use simple LOGO! commands to control the Edutrainer control elements.

Module Contents:

1.1 Introduction

In everyday operations or industrial processes, we come across situations where there is a need to control some device or a physical quantity such as time, temperature, sound, light and so on, to get the required result or output.

For example, do you think an airplane would be useful to a pilot, if he cannot make it go where he wants it to go? Or would an air-conditioner be useful, if the temperature in a room cannot be controlled? In both the examples, there is a need to **control** a process.

Control is a broad term that means anything from a toggle switch to a complex system of components. Control can either be manual or automatic.

Fig 1.1: Examples of Control

Manual Control

Control is said to be done manually when a user performs an action for the system to function. For example, the user might flip the switch of a manual starter to start and stop a motor (fig 1.2)

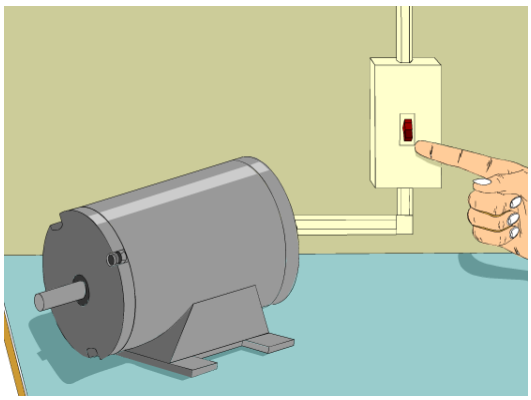


Fig 1.2: Example of Manual Control

Automatic Contol

Control is said to be automatic when the action is performed automatically in response to set conditions.

Fig 1.3: Example of Automatic Control

Machines can be controlled manually or automatically. Usually, there is a combination of manual and automatic control. For example, a process that is started manually may stop automatically when certain conditions are met.

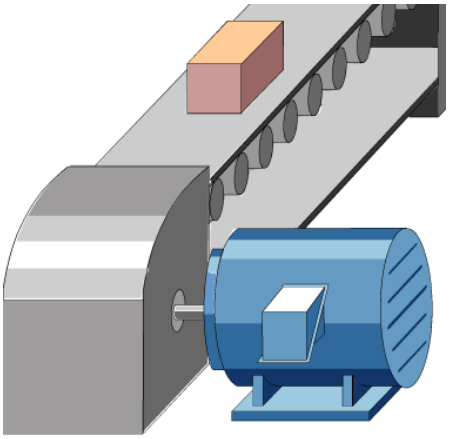


Fig 1.4: Manual & Automatic Control Example

From the examples, it is clear that a **Control System** is a system that can sense, switch and/or control an operation. It operates on an input signal and controls the process in order to provide an output signal. This is shown in the block diagram in fig 1.5:

Fig 1.5: Elements of a Control System

1.2 Programmable Logic Controller (PLC)

A Programmable Logic Controller (or PLC) is a specialised digital controller that can control machines and processes. They monitor inputs, make decisions, and control outputs in order to automate machines and processes. Fig 1.6 demonstrates its function.

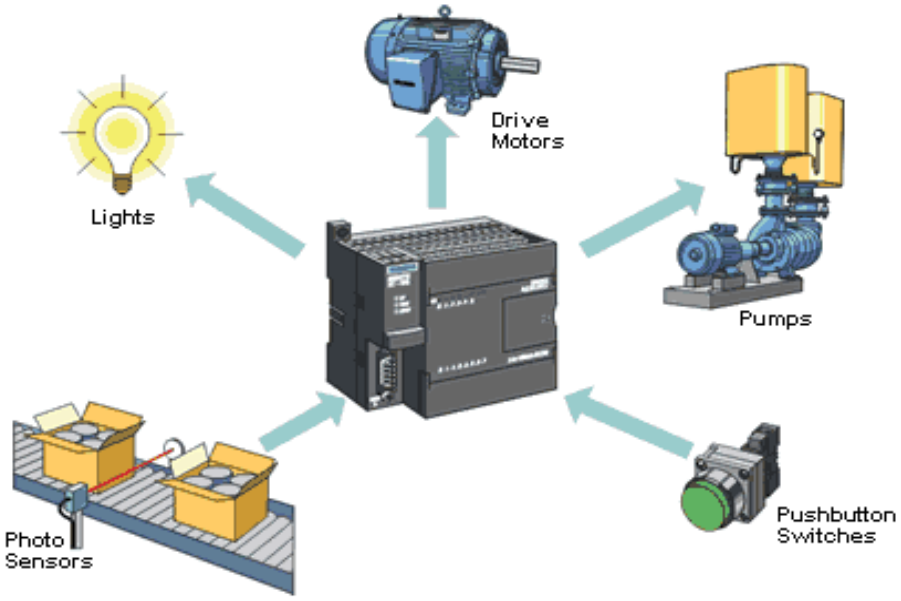


Fig 1.6: PLC Function demonstration

PLCs have been used for industrial and commercial applications. Almost any production or assembly line, machine function or process can be controlled by a PLC.

Fig 1.7: PLC

PLC Advantages

- They are highly reliable, fast and flexible.
- They can handle severe conditions such as dust, humidity etc.
- They are less expensive.
- They can communicate with other controllers.
- They are easy to program and troubleshoot.

Basic PLC Operation

In the example shown in fig 1.8, pushbuttons are connected to the PLC's inputs and a motor is connected to the PLC's output. Here the pushbuttons are used to start and stop the motor.

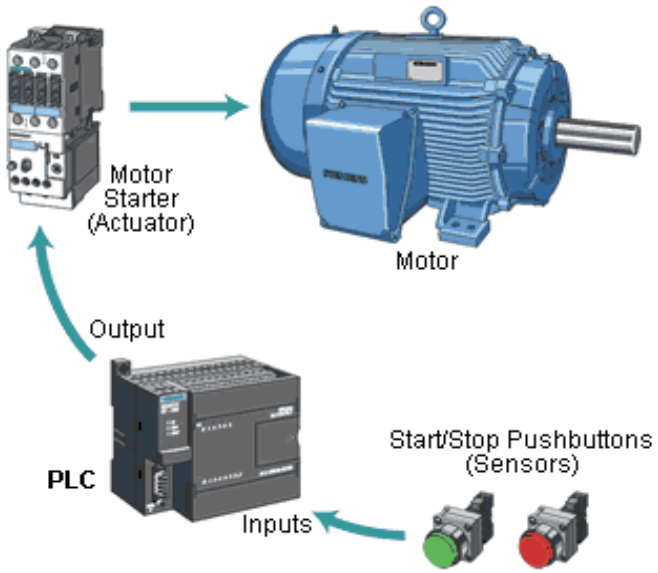
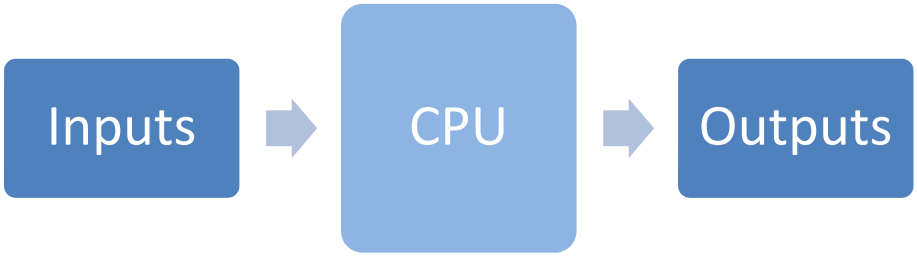


Fig 1.8: Motor control using a PLC

PLC Basic Parts

A PLC consists of the following basic parts:

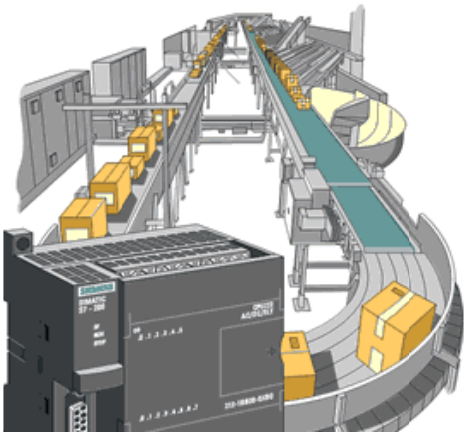
- Inputs
- Central Processing Unit (CPU)
- Outputs



- Examples of PLC input devices are sensors,switches,pushbuttons etc
- Examples of PLC output devices are valves, motors, solenoids etc

PLC Applications

A PLC can be used in a wide range of applications, some of which are shown below:



Production and assembly lines

Automatic Doors

Traffic Lights

PLC Manufacturers

The PLC that will be introduced in this course is the **LOGO! PLC** from **Siemens**.The table below shows a list of other PLC Manufacturers.

ABB	Mitsubishi	Siemens	Toshiba
Bosch	Omron	Telemecanique	

1.3 Lab Activity 1

Objective: To familiarise with the Siemens LOGO! PLC Module.

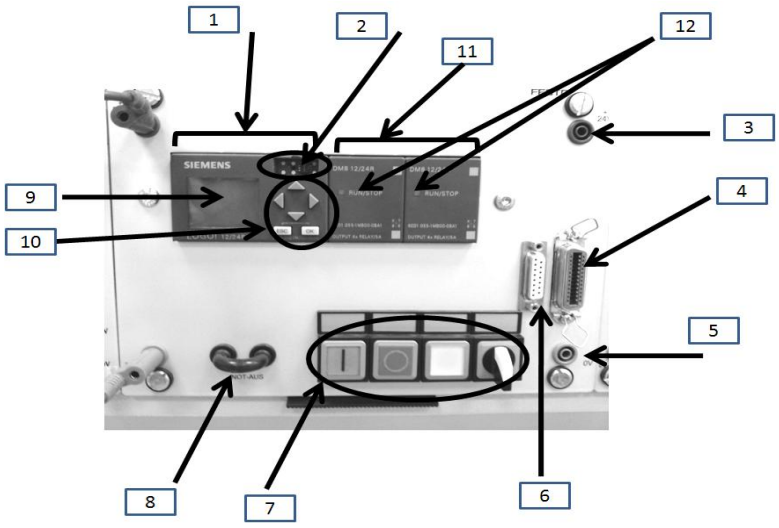
Procedure: The following are the 12 main components of the LOGO! Basic PLC module:

- One LOGO! Basic which operates on 24V dc supply and has:
  - 6 digital inputs
  - 2 analog inputs
  - 4 digital outputs

- Display unit
- Control Unit for LOGO! Programming
- PC Interface
- Two expansion modules that have:
  - 4 digital inputs
  - 4 digital outputs

- Status display LEDs that indicate RUN/STOP status
- Submin D Socket
- 24VDC safety socket
- 0V safety socket
- Control elements
- Emergency-stop bridge
- SysLink Interface

1. Identify the LOGO! Basic PLC module components on the EduTrainer that are marked in the figure and write them in the table provided:



Number	Component/Part
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

Table 1.1

Review the parts and mark them in the picture below:

2. Identify the three parts on the LOGO! Basic **control unit** and name them:

   1. _____

   2. _____

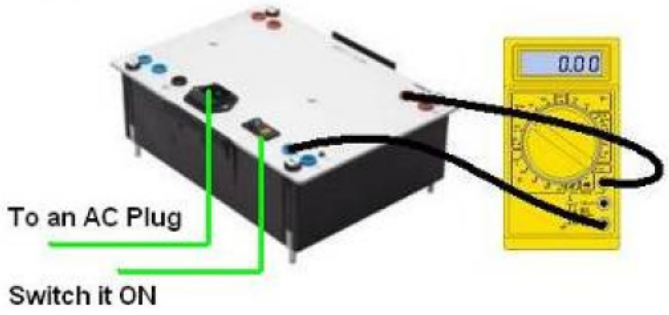
   3. _____

   What is the function of this unit?

   _____

   _____

3. Measure the output voltage of the power supply unit with the help of a multimeter as shown in figure below:



   Record the dc output voltage.

   _____

1.4 Lab Activity 2

Objective: To familiarise with the LOGO! Basic Control unit using simple commands.

Procedure:

1. Set the day, time and date

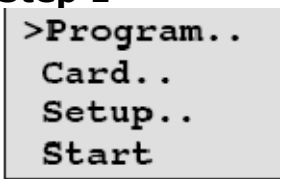
   Follow the steps below to set the day, time and date.
   - Switch on the power supply.
   - Press the *ESC* key on the LOGO! Basic module
   - Select *Set*
   - Select Clock
   - Press the ▲ and ▼ to change the day and press *OK* to confirm.
   - Move to date by using the side arrows.
   - Follow the same procedure to set the date and year and press *OK* to confirm.
   - Press ESC to return to the main screen.

2. Enter your first program on LOGO! using the on-board keys.

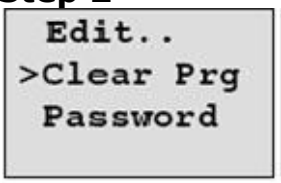
   The digital inputs are denoted by the letter I such as I_1, I_2 and so on, and the digital outputs are denoted as Q_1, Q_2 and so on. Program the PLC to turn on Q1 when I3 is ON.

   Press ESC to come to the main screen and follow the steps below:

Step 1

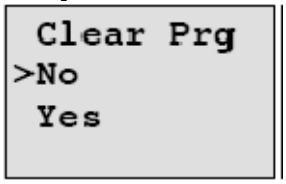


Step 2



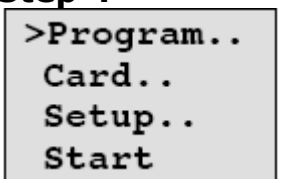
Clear prg clears previous program

Step 3

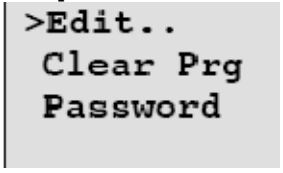


Press Yes and press *OK.*

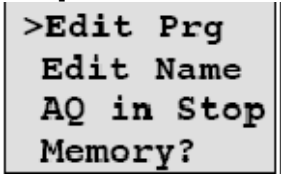
Step 4



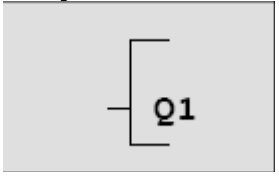
Step 5



Step 6

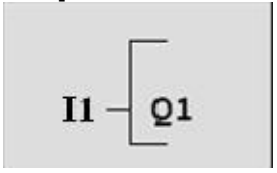


Step 7



Select **Q1** as output

Step 8



Select **I3** as input by using the OK button.

Observation:

1. Press ESC to return to the main screen and press *start* to run the program.

   Press the white pushbutton (I3) and observe the result. Can you identify the Q1 output? What do you observe?

   _____

   _____

2. Stop and clear the program. Repeat the steps by changing the input to I1. What do you observe?

   _____

   _____

3. Based on your experiment, identify which control element is connected to the following PLC inputs and outputs:

PLC input	Control Element
I3	
I1	

PLC Output	Control Element
Q1	

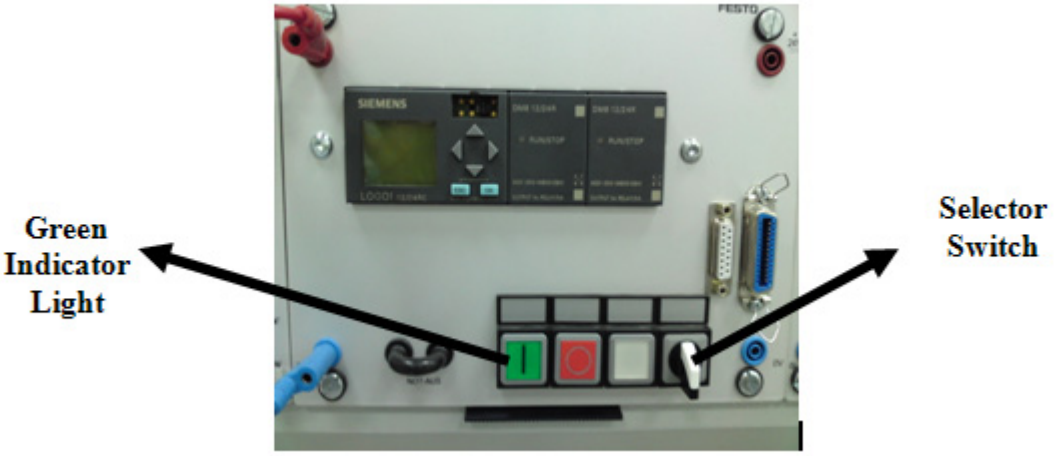
Table 1.2

1.5 Lab Activity 3

Objective: To perform simple control tasks by entering commands through the BASIC Control Unit.

Procedure:

A. Write a program to turn on the Green Indicator light when the selector switch is turned on. Refer to table 1.3 to identify the inputs and outputs.



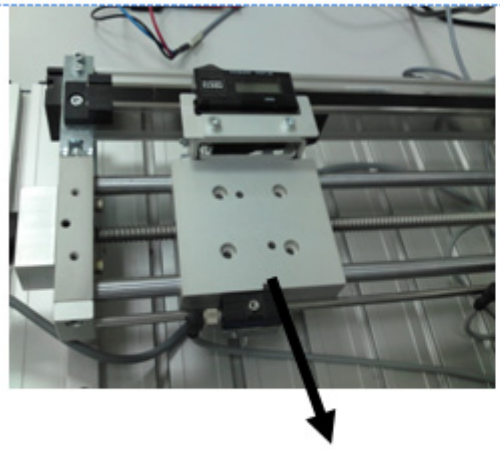
Control Elements	PLC Input/Output
Selector Switch	I4
Green Indicator Light	Q1

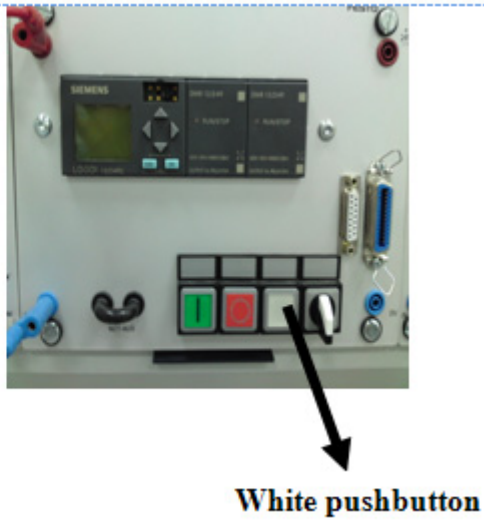
Is it possible to leave the green light in the ON state? What is the difference you observe between the pushbutton and the selector switch?

_____

_____

B. Write a program to move the table forward when the white pushbutton is pressed.





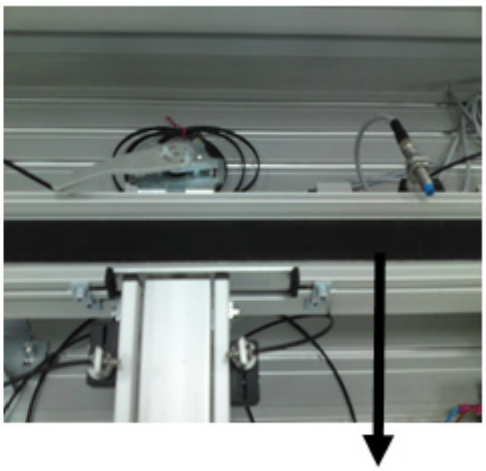
Control Elements	PLC Input/Output
Table (forward)	Q5
Table (backward)	Q6
White pushbutton	I3

What changes should you make in the program to move the table backward when the white pushbutton is pressed?

_____

_____

C. Write a program to start the conveyor belt motor when the green pushbutton is pressed.



Control Elements	PLC Input/Output
Conveyor belt motor	Q8
Green pushbutton	I1
Branching arm	Q7

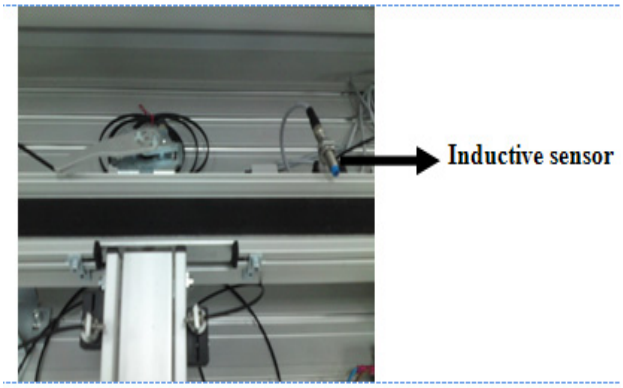
What changes should you make in the program to move the branching arm when the green pushbutton is pressed?

_____

_____

D. Write a program to turn on the White indicator light when the inductive sensor senses a metal piece.

White Indicator Light



Control Elements	PLC Input/Output
White Indicator light	Q2
Inductive sensor	I12

What changes should you make in the program to move the branching arm when this sensor senses a metal piece?

_____

_____

1.6 Module Exercise

1. What are the elements of a control system? Include the elements to complete the block diagram given below:

2. PLC stands for _____ _____ _____

3. What is a PLC?

_____

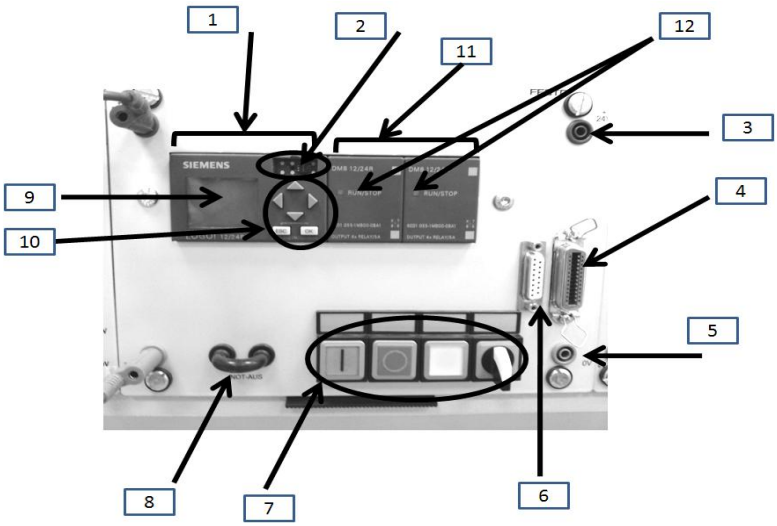
_____

_____

4. Based on your knowledge of microcontrollers, what do you think is the difference between a PLC and a microcontroller? Complete the T-chart below to show the difference:

PLC	Microcontroller

5. Mark the parts that are indicated in the table below:



Number	Component/Part
1	
3	
4	
8	
11	
12	

6. List three advantages of using a PLC:

_____

_____

_____

1.7 Assignment

Complete any one of the tasks using any one of the suitable Microsoft Office tools.

Task-1:
Use the internet to identify one commercial application and two industrial applications of a PLC other than the ones listed in the module, and prepare a powerpoint presentation or a poster that lists those PLC applications.

The powerpoint slides (or the poster) must include the following contents:

- Assignment Title: PLC Applications
- Title of application-1, picture and brief description.
- Title of application-2, picture and brief description.
- Title of application-3, picture and brief description.

Task-2:
Prepare a powerpoint presentation or a chart that includes the following:

- A picture of the Logo! Basic Control unit with all its parts marked neatly.
- A list of all the LOGO! Edutrainer control elements that you have used in your lab activities in this module. Include the following details:

Control Element	Input or Output?	PLC Input/Output