Exercise 1

Contents

Introduction

This first exercise is about getting to know the TwinCAT 2 developement environment and the provided documentation (TwinCAT Materials).

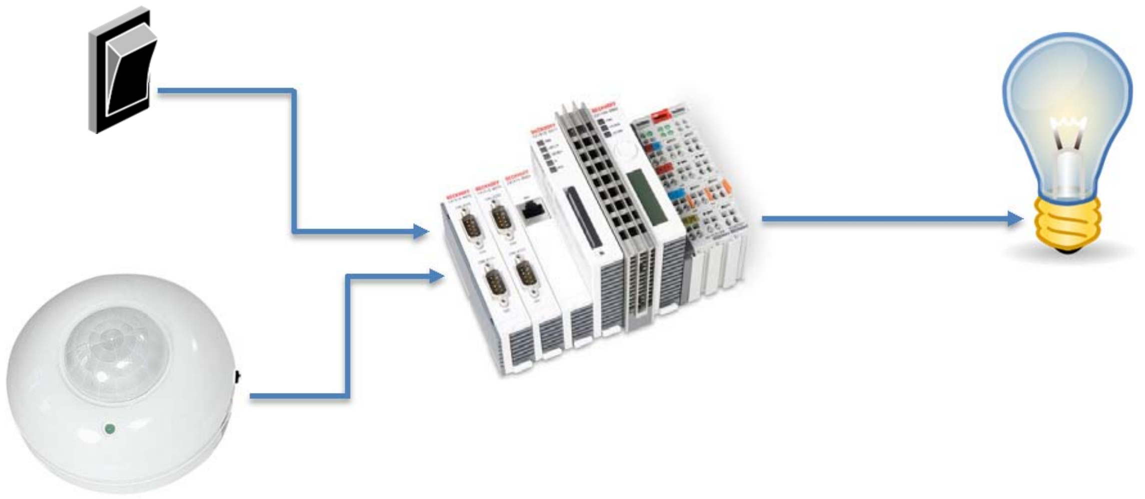
PLC in a nutshell

A PLC (Programmable Logic Controller) works like the following:

1. Read hardware sensors
2. Process the obtained information and decide what needs to happen
3. Write to the hardware actuators

Those 3 steps are repeated indefinitely.

For instance:
A PLC has a switch and a brightness sensor as inputs and a light as an output.



This looks fairly complicated to just control a light! So what is the advantage of the plc instead of wiring it together directly? We gain a lot of flexibility! We can program the plc in different ways:

- Turn the light on with the switch and use the presence sensor to turn it off automatically later
- Turn the light on if the presence sensor detects a person
- ...

Furthermore, it is possible to easily add other sensors and actuators. In the upper example a brightness sensor could be handy to only turn on the light when it's dark enough. Therefore, we can make this application as sophisticated as we wish.

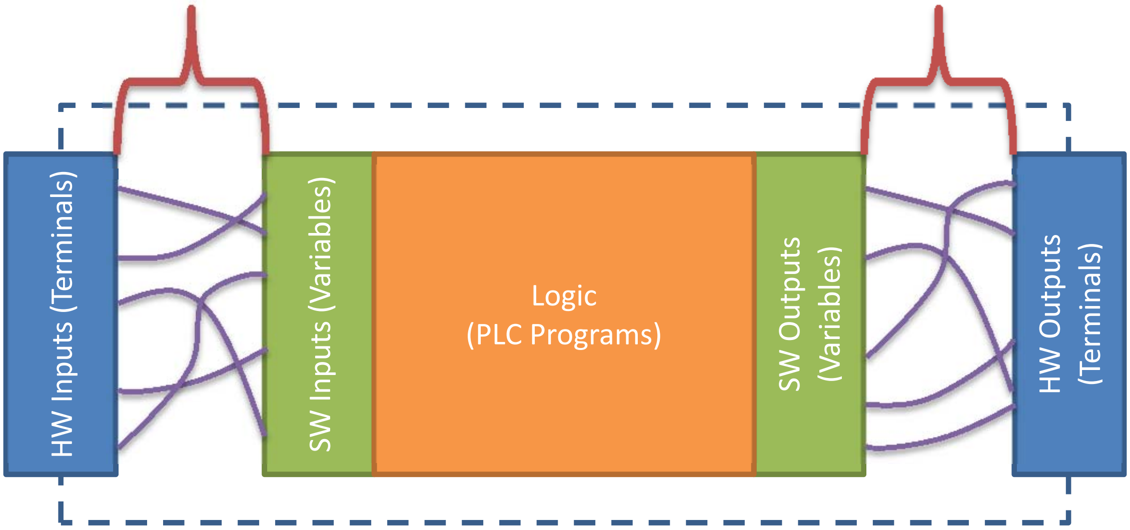
Exercises

1. Read the TwinCAT Guide

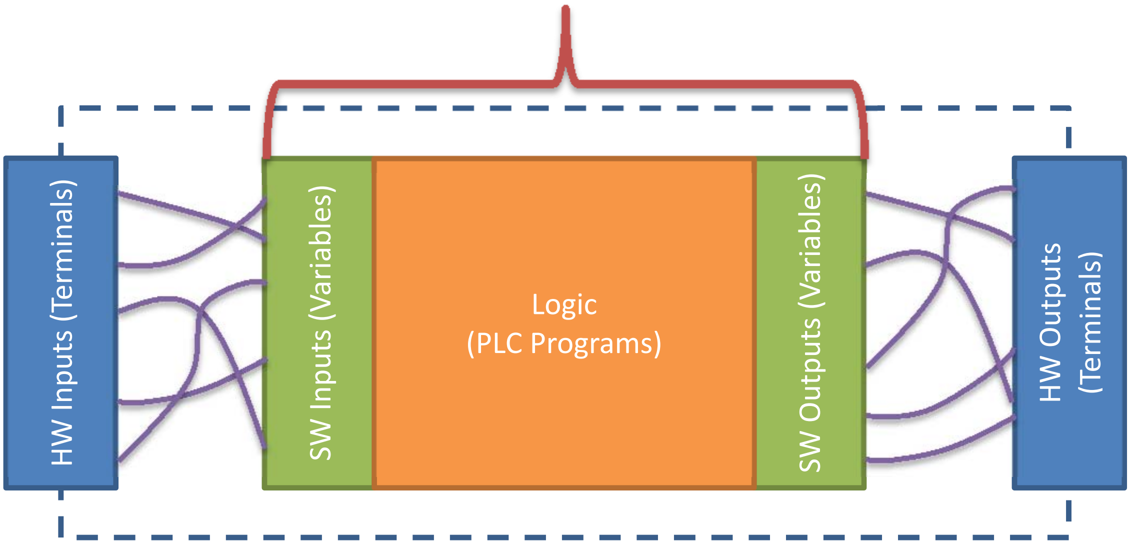
The document "TwinCAT Guide" shows you how to use the different TwinCAT programs in the development process.

The 3 applications explained are:

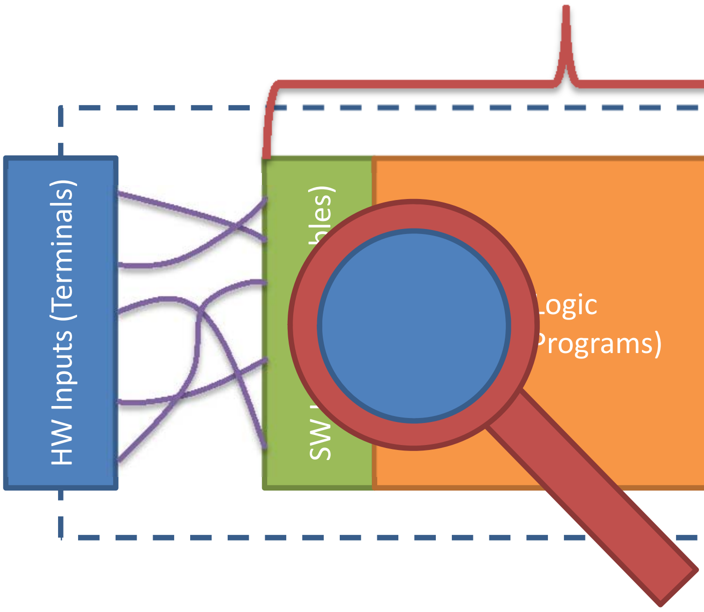
1. System Manager: It is used to configure the TwinCAT system and connect hardware terminals to software variables. Basically it connects the hardware with logic.



2. PLC Control: It is used to program and execute the logic.



3. Scope: It is used to measure values of SW variables over time.



2. Connect PC and PLC

To establish a connection between your PC and the PLC work through the following topics of the "TwinCAT Guide":

1. Power the PLC
2. Establish connection
3. Open System Manager
4. Select Target System
5. Run Mode

3. Read the ST Reference

To program the logic our programming language of choice is ST (Structured Text). The document "ST Reference" explains the different parts of the programming language and provides small examples.

4. Write your first project

Unfortunately the term "program" has a different meaning in ST than in every day use. That is why we use the term "project", which can consist of several programs.

Work through the following topics of the "TwinCAT Guide":

1. Open PLC Control
2. Create new PLC project

Before we go on, disable 2 annoying features:

1. Select Project / Options...
2. Select Category "Editor"
3. Disable "Autodeclaration" and "Autoformat"
4. Click Ok

Now you have a project with a MAIN program. It is a tradition in every programming language to write a program which writes "Hello World" to the output. In TwinCAT we do not have an easy way to do that. Therefore, we do the following:

- Create the variable "counter" of type INT and set it's initial value to 0.
- Create the variable "sayHelloWorld" of type BOOL and set it's initial value to FALSE.
- Use an IF statement to set sayHelloWorld to TRUE as soon as the counter reaches 500.
- Use an IF statement to set sayHelloWorld to FALSE and counter to 0 as soon as the counter reaches 1000.
- Increment the value of "counter" by 1. Remember everything is executed in a loop so the counter will keep on counting.

To run this project work through the following topics of the "TwinCAT Guide":

1. Compile the project
2. Run project

Another important topic is debugging. Therefore, work through the following topics of the "TwinCAT Guide" and apply it to your running project:

- Debugging
- Breakpoints
- Stepping
- Changing value of variable

5. Analyze your project with the Scope

To analyze the values of variables over time we can use the Scope.

Work through the following topics of the "TwinCAT Guide":

1. Open Scope
2. Configuration (add a channel for counter and sayHelloWorld)
3. Measure
4. Change axis limits

6. Sun and Moon Simulator

Now you're ready to create a program that simulates the sun and moon for a month:

1. Create a new project called SunMoonSimulator with a MAIN program.
2. You're program should acomplish the following:
   a. BOOL variable "sunShines" indicates that the sun shines (7:00 to 20:00).
   b. BOOL variable "moonShines" indicates that the moon shines (23:00 to 4:00).
   c. BOOL variable "isFullMoon" indicates that it is a full moon (night of the 3rd day of the month).

Hint: Use 3 INT counters to count the minutes, hours and days.