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An Application for the Improvement of the Transportation System of the Flour in a Grain Mill using "PID Compact"

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The paper presents an application based on a PLC Simatic S7-1200, using the "PID_Compact" logical function, which can be used for the improvement of control systems. We also present a practical application: a system for the improvement of the transportation system of the flour in a grain mill using "PID Compact".

Keywords*: PLC, control, PID compact*

1. Introduction

This paper is a continuation of [1], in which we approached the problem of regulating the flour transportation system in a grain mill by using a pressure controlling system based on a Simatic S7-1200 PLC.

In this paper we approach the problem of the improvement of this process by using a temperature system; we use a regulator of PID type [2] implemented using a Simatic S7-1200 PLC [3], using the logical function "PID_Compact" [4].

2. The general block diagram

A general block diagram for the study of the system with "PID_Compact"[4], with highligths of the main components we used, is presented in Figure 1.

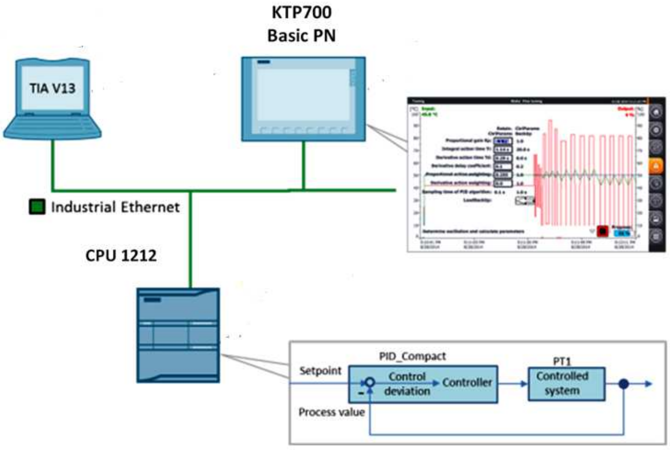

Figure 1. Highlighting the components of the control system with PLC S7-1200 by using the logical function "PID_Compact"

3. The PID_Compact module

"PID_Compact" is a controller of PIDT1 type, with the value for the output y determinated using the relation:

$$y = K_p \left[(b \cdot w - x) + \frac{1}{T_I \cdot s}(w - x) + \frac{T_D \cdot s}{a \cdot T_D \cdot s + 1}(c \cdot w - x) \right]$$

where:

K_p - proportionality constant

b – weight of the P component

x – current value

T_I - integration time

T_D - derivation time

w - input variable

a - coefficient for differential delay (T1 = a × TD)

c – weight of the D component

s – the Laplace operator

The functional block diagram of the PID module is presented in Figure 2:

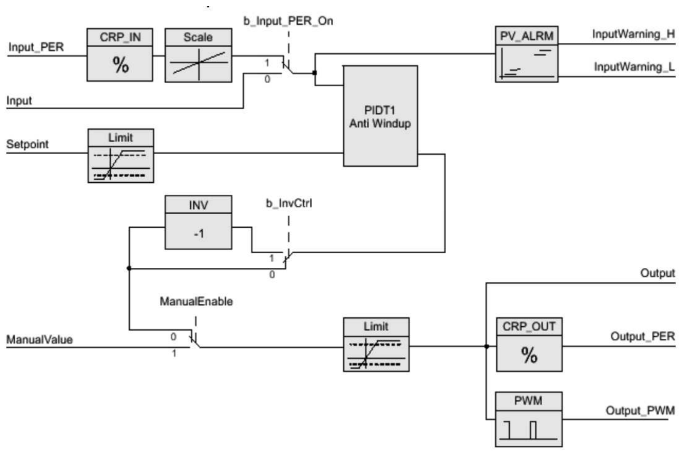

Figure 2. PID_Compact – the block diagram

4. User's interface

The interfacing with the user is done, mainly, by 6 screens, presented in Figure 3:

1. Display of the evolution
2. Adjustment for the regulator's functioning
3. Monitoring
4. Visualization of the alarms
5. Configuration
6. Simulation

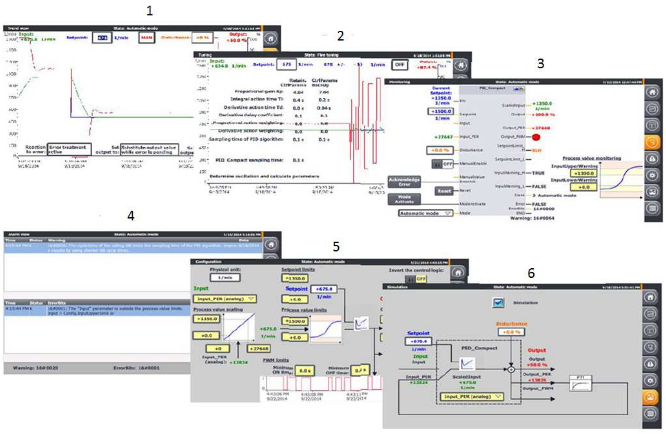

Figure 3. The screens for the user's interface.

5. The functional description of the application's blocks

The command circuit is calculated iteratively in the OB block, following the minimisation of errors.

The "Switch" function allow switching between a real time control system (evaluation of the signals using control peripheral) and a simulation of the system.

The selected signals are then transmitted to the "PID_Compact" operator as input parameters. Based on the condition

error = reference value – current value

and depending on the PID parameters, the controller computes the modified value, which is then transferred as analog signal or digital signal of the PWM type, to the control exits I/O.

The working variable is transferred to the "PROG_C" block as a floating point number.

The "PROG_C" block simulate a behavior of a PT1 system and transmits the real value as a floating point number, which is converted into an analog value by the "Scale_Real2Int" block.

In the error simulation block, the current value is replaced with the wrong value (-32768) and then transferred to the simulated analog entry of the "Input_PER_simulated" of the "Switch" block.

Also, the analog simulated value is converted to the corresponding number of the "Input_simulated" entry by "Scale_Int2Real".

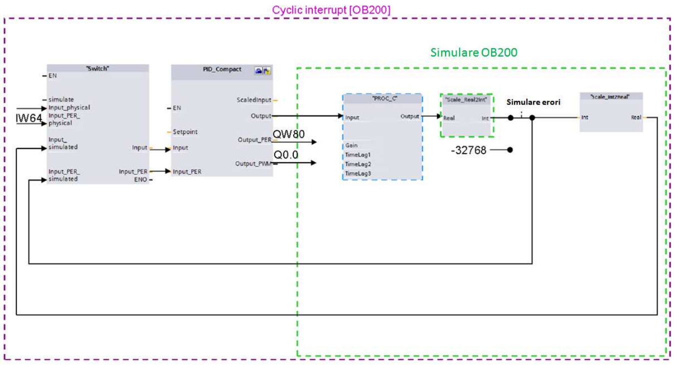

Figure 4. The programme of the application

6. A practical application

To implement the application we described above, we started from a previous configuration.

For the realisation of the programs, we used the specifically language of the Siemens automaton of last generation, the TIA Portal [3], with a recent upgrade including the packages STEP 7 and WINCC Flexible.

Figure 5. The PT 1000 temperature sensor.

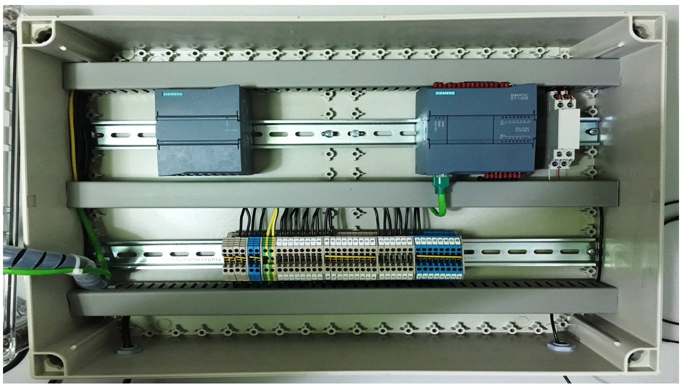

Figure 6. Execution detail.

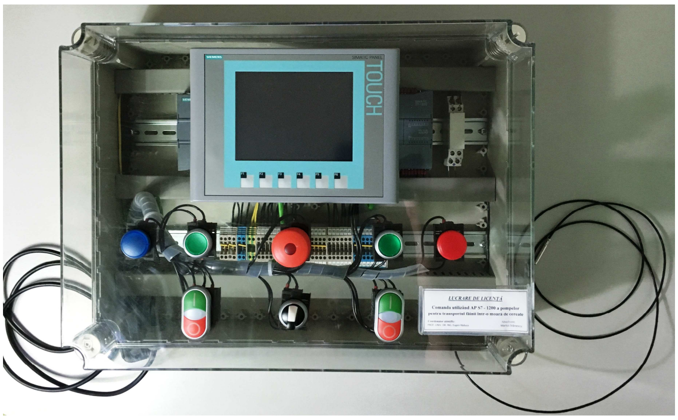

Figure 7. The box which contains the TOUCH panel.

Figure 8. The temperature switch.

The results obtained during the experiments are displayed on the TOUCH HMI pannel, this being used also for configure, display, monitor and modification of the parameters during the process.

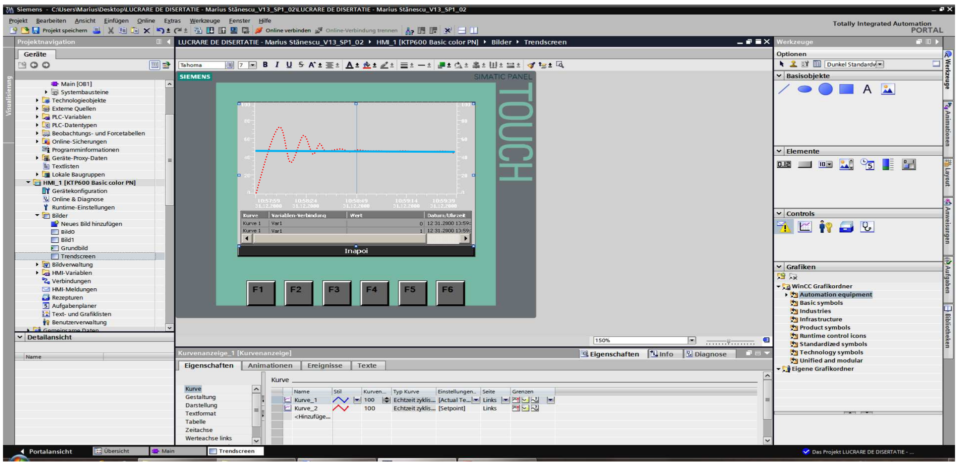

Figure 9. The display for the regulated signal

We presented, in figures 5-9, various aspects of the realised device.

7. Conclusions

We realised a practical model which can be used for a on phase monitoring, on a HMI - KTP600 PN Basic display, the implementation of controllers with the Simatic S7 – 1200 platform. The system was designed for both manual and automatic function regime. The practical system was designed to be used for the improvement of the transportation system of the flour in a grain mill.

The presented application offers many advantages, from which we mention several:

- A step by step description for the commissioning of a PID_Compact controller
- Easy access in the settings of the functions of PID_Compact
- Switching between the automatic and the manual regime
- The curves for the nominal value and of he real value can be modified in a convenient way
- Switching between the real control mode and the simulation mode
- Controlling of the disrupting variable in the simulation mode
- Specification and simulation of the evolution of errors
- Manual input of the parameters for control and automatic regulation
- Online monitoring of the "PID_Compact" command block
- Changing the configuration during the runtime

References

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