

# Cascade Control System Using Pid Controller (Pi, Pd, Pid Control Study) + Smart Twincat3 HMI Development

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*Abstract: It is an automation based project, which gives us brief information about various types of PLC controllers like PI, PD, and PID. The implementation is displayed on HMI screen using software TwinCAT 3. The logic is developed using programming languages structured text, Ladder diagram and function block diagram on HMI development using TwinCAT 3. Cascade Control is an advanced application of the PID that can improve control of systems which are disturbed because of some lag. Since respond of such systems are slow to disturbances their performance can suffer with each factor. The Cascade system can be applied to such slower processes. When applied it will impact on its slower process, allowing for smoother control and enhanced performance.*

*Keywords: cascade control system, PID controller, TwinCAT 3 software, HMI, greenhouse*

## I. INTRODUCTION

A control system is a device, or set of devices, that manages commands, directs or regulates the behavior of other devices or systems. Industrial control systems are used in industrial production for controlling equipment or machines. There are two common classes of control systems, open loop control systems and closed loop control systems. In open loop control systems output is generated based on inputs. In closed loop control systems current output is taken into consideration and corrections are made based on feedback. A closed loop system is also called a feedback control system. Logic control systems for industrial and commercial machinery were historically implemented at mains voltage using Interconnected relays, designed using ladder logic. Today, most such systems are constructed with programmable logic controllers (PLCs) or microcontrollers. The notation of ladder logic is still in use as a programming idiom for PLCs. When multiple sensors are available for measuring conditions in a controlled process, a cascade control system can often perform better than a traditional single-measurement controller.

Applications with two or more capacities (such as heated jackets) are inherently difficult to control with a single control loop due to large overshoots and unacceptable lags. The solution is a cascade of two or more control loops, each with its own input, in series forming a single regulating device. Cascade control should always be used if you have a process with relatively slow dynamics (like level, temperature, composition, humidity) and a liquid or gas flow, or some other relatively-fast process, has to be manipulated to control the slow process. For example: changing cooling water flow rate to control condenser pressure (vacuum), or changing steam flow rate to control heat exchanger outlet temperature. In both cases, flow control loops should be used as inner loops in cascade arrangements Cascade control should always be used if you have a process with relatively slow dynamics (like level, temperature, composition, humidity) and a liquid or gas flow, or some other relatively-fast process, has to be manipulated to control the slow process. For example: changing cooling water flow rate to control condenser pressure (vacuum), or changing steam flow rate to control heat

exchanger outlet temperature. In both cases, flow control loops should be used as inner loops in cascade arrangements.

From last few years, there has been a popularity rise of computers for control of greenhouse. Greenhouse cultivation represents a very important role in modern agriculture. As the greenhouse usually equips with various high-tech equipment, management tend to be very complex. A fully automated greenhouse control systems bring obvious benefit such as labor saving, but far more importantly, it enables improved quality of produce and information gathering that will make difference between earning a profit and suffering substantial losses

## II. PROJECT OBJECTIVE

A greenhouse allows the growers to produce plants in places where the climate would otherwise be unfeasible for the growing of plants. The greenhouse also provide shelter for the plants, protects them from harsh weather condition, insect and diseases. It allow plants to grow under optimum conditions, which maximizes the growth potential of the plants. The quality and productivity of crop plants is highly dependent on the management quality and a good management scheme is defined by the quality of the information gathered from the greenhouse environment.(1)

The greenhouse system is complex system, any significant changes in one climate parameter could have an adverse effect on another climate parameter as well as the development process of plants. Therefore, continuous monitoring and control of these climate factors will allow for maximum crop yield

## III. SOFTWARE

TwinCAT 3 is the software used for programming of PLC. Basically it is software developed by BECKHOFF. This software provides programming languages for PLC like structured text, ladder diagram, and function body diagram etc. HMI development can be done in this software.

## IV. OPERATION OF SYSTEM

Greenhouse is controlled using cascade control system. Cascading of two PLCs is done so to have an enhanced performance of the system. Sensors senses the parameters which will be given to the 1st PLC. Set point is to the 1st PLC which will compare the set point and the output of the sensor. The difference between them is given to the 2nd PLC which will take corrective action and feedback is given to the 1st PLC which will again compare the set point and feedback and again a corrective action will be taken by 2nd PLC.(2)

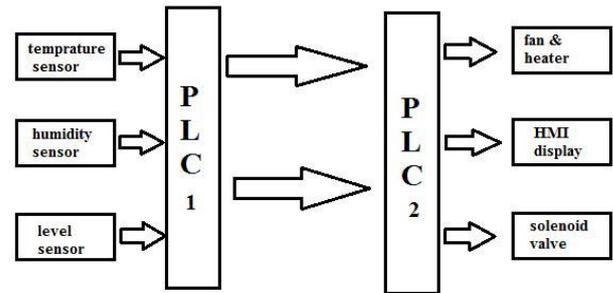


Figure 1

## V. SOLENOID VALVE



Figure 2

A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of two port valve the flow is switched on or off; in the case of three port valve, the outflow is switched between the two outlet port. Multiple solenoid valve can be placed together on a manifold. Solenoid valve are the most frequently used controlled element in fluidics. (3)

## VI. LEVEL SWITCH MAGNETIC FLOT SENSOR

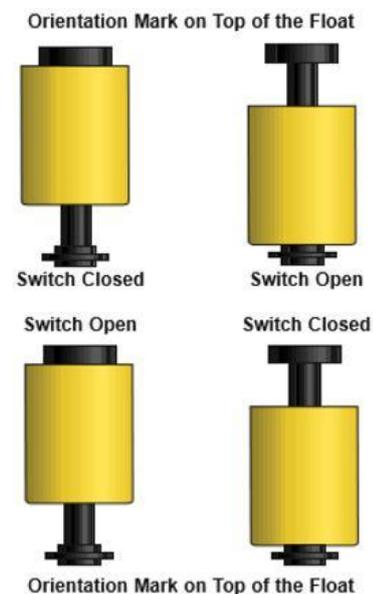


Figure 3

We are offering a comprehensive range of Float Switch that can be added as an optional extra to the pump to control the water level in a tank and dam by switching the pump on and off electronically on low and high water level positions. It can be connected to the control box from where switching of the pump is controlled.(3)

## VII. CONCLUSIONS

The green house control system is a cheaper solution as compared to other similar technologies and hence suitable for the developing countries such as India. Low cost and maintenance free sensors are used to monitor environment. The system has several advantages in term of its compact size,

low cost and high accuracy. The green house system considers design optimization and functional improvement of the system. The reprogramming and flexibility are the main features. The same system can be used to monitor industrial parameters also.

## REFERENCES

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