WATER TANK LEVEL CONTROL USING PID (PROPORTIONAL INTEGRAL DERIVATIVE) CONTROLLER

SABRI BIN BALADI

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Faculty of Electrical Engineering
Kolej Universiti Teknikal Kebangsaan Malaysia

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"I / we accepted that have been read this kind of report, In my / our opinion this kind of report suppose in the scope and quality for purpose to award the Degree of Bachelor In Electrical Engineer (Industrial Power)."

Signature : ....

Supervisor's name : SYED NAJIB BIN SYED SALIM

Date : 11/3/2005

"I admit this report is written by me except the summary and extraction for each I have been clearly presented"

Signature :...................................

Writer Name : SABRI BIN BALADI

Date : 11 / 03 / 2005

DEDICATION

To my parents

Baladi (Hj Ibrahim) and **Hajjah Hawa**

In appreciation of their patient and understanding.

ACKNOWLEDGMENT

Firstly, I would like to express grateful to All Almighty because only through His guidance, I can complete this project.

Alhamdulillah, great thankful to Allah because with the consent of Allah I finished the Bachelor Degree Project (PSM) about Water tank level control using PID controller. Behind the development and process of this project from the early phase, there are some important peoples that help and contribute towards the success of the project. Without their contribution, I cannot complete the project with satisfaction. First of all, special thanks to Encik Syed Najib Bin Syed Salim my supervisor, who gave me instruction and guidance during the project development. With his guidance, all of the hesitation about my study and analyze about the development of the project revealed..

Lastly, thanks to my friends who also give me guidance and help in completing this project. I wishes to convey my sincere gratefulness to all those who contributed in accomplishing this project successfully.

ABSTRACT

The technology of artificial control was first develop using a human as a integral part of the control action. When we learned how to use machines, electronics and computers to replace the human function. In this term the automatic control will came in handy. About my PSM, I try to develop what call 'Water Tank Level Control' by using PID (Proportional Integral Derivative) controller. The concept of this process, is to control the level of the water in the tank and make sure, the level of water always to follow the range that has been set. The main control are used in this process is PID controller, in this case the final control element is a valve which the function of the valve is control outflow of the water. The d.c motor receive the input from PID controller to move the valve. The sensors function as a feed-back where it's will give the information to PID controller whether the water is in the range or not. Simulation by using simulink 4 also involved in order to design PID controller.

ABSTRAK

Dalam teknologi kawalan , ianya dibangunkan pada awalnya menggunakan sistem kawalan berdasarkan pada kawalan gerakan tubuh manusia. Apabila kita mempelajari menggunakan mesin, litar elektronik dan komputer bagi menggantikan fungsi manusia dalam proses kawalan. Dalam Projek Sarjana Muda, saya mencuba membangukan satu sistem kawalan paras air di dalam tangki dengan menggunakan pengawal PID (Proportional Integral Derivative). Di dalam proses ini, ianya menggunakan konsep pengawalan paras air di dalam tangki untuk memastikan takat air berada pada paras yang dikehendaki. Kawalan utama dalam proses ini ialah pengawal PID yang berfungsi mengawal valve untuk mengawal kemasukan aliran air ke dalam tangki. Motor d.c akan menerima isyarat dari PID untuk mengawal valve, Pengesan akan bertindak sebagai isyarat suapbalik kepada PID apabila berlaku perubahan paras air . Proses simulasi bagi pembangunan awal projek ini menggunakan perisian simulink 4, yang bertujuan untuk merekabentuk litar pengawal PID.

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CHAPTER 1

INTRODUCTION

1.0. Introduction.

In process control, the basic objective is regulate the value of some quantity. To regulate means to maintain that quantity at some desire value regardless of external influences. The desired value is called the reference value or set point.

1.1 Project Objective.

- To study about Water tank level control.
- To study about PID controller.
- To study about simulink 4.
- To build hardware of water level system.
- Design the PID controller circuit.
- Testing and analaysis.

1.2 The Process (Problem Statement).

Figure 1.1 shows the process to be used for this discussion. Liquid is flowing into a tank some rate, Qin, and out of the tank at some rate, Qout. The liquid in the tank has some height or level, h. It is know that the output flow rate varies as the square root of the height, Qout = K√ h , so the higher the level, the faster the liquid flows out. If the output flow rate is not exactly equal to the input flow rate, the level will drop, (Qout > Qin) or rise, if (Qout < Qin).

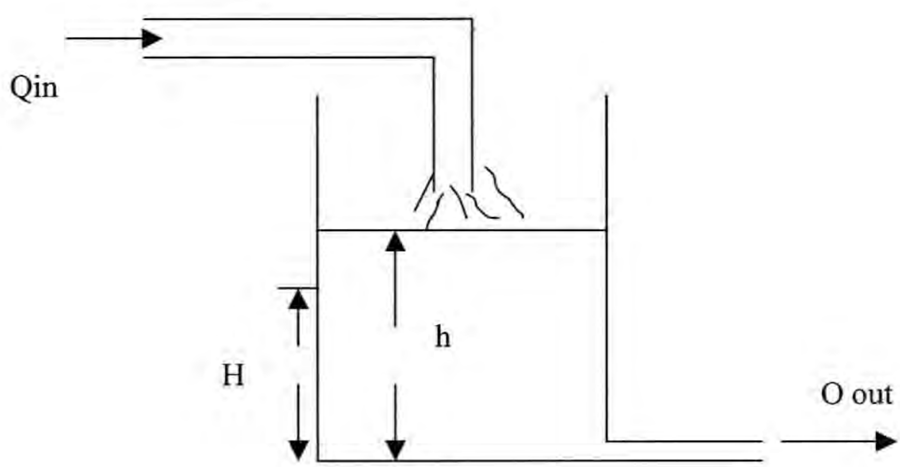

Figure 1.1: The objective is to regulate the level of liquid in the tank, h, to the value H.

This process has a property called self-regulation. This means that for some input flow rate, the liquid height will rise until it reaches a height for which the output flow rate matches the input flow rate. A self-regulating system does not provide regulation of a variable to any particular reference value. In this example, the liquid level will adopt some value for which input and output flow rate are the same, and there it will stay. But if the input flow rate changed, then the level would change also, so it is not regulated to a references value.

Suppose we want to maintain the level at some particular value, H, in Figure 1.2 regardless of the input flow rate. Then something more than self-regulation is needed.

1.3 Human-Aided Control.

Figure 1.4, shows a modification of the tank system to allow artificial regulation of the level by a human. To regulate the level so that is maintains the value H, it will be necessary to employ a sensor to measure the level. This has been provided via a "sight tube," S, as show in Figure 1.4. The actual liquid level or height is called the controlled variable. In addition, a valve has been added so that the output flow rate can be changed by the human. The output flow rate is called the manipulated variable or controlling variable.

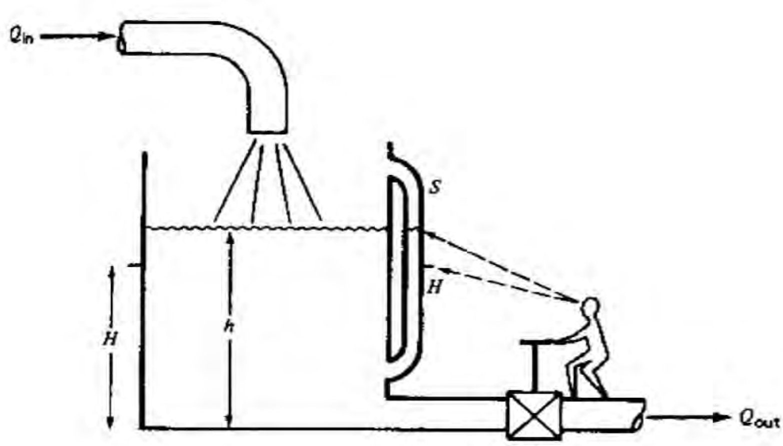

Figure 1.2 : A human can regulated the level using a sight tube S to compare the level h to the objective H and adjust a valve to change the level.

Now the height can be regulated apart from the input flow rate using the following strategy: The human measures the height in the sight tube and compares the value to the set point. If the measured value is larger, the human opens the valve a little to let the flow out increase, and thus the level lowers toward the set point. If the measured value is smaller than the set point, the human closes the valve little to decrease the flow out and allow the level to rise towards the set point.

By a succession of incremental opening and closing of the valve, the human can bring the level to the set point value, H, and maintain it there by continuous monitoring of the sight tube and adjustment of the valve. The height is regulated.

1.4 Scope Of Project.

Close Loop Water tank Level Control System

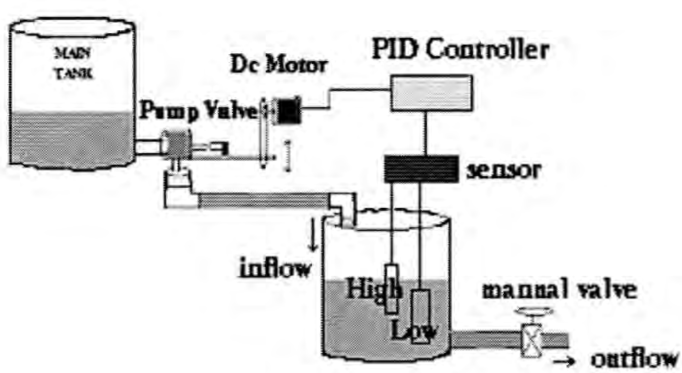

Figure 1.3 : Model of Water Tank level Control Using PID Controller.

The level of the water in the tank will be detected by the sensor, and in will consider of an input, and will be measured by **e** (digital multimeter). Than it will be sent to the PID controller. Than the output will be sent to the servomotor for its operation to open or closed the value the water into the tank.

The valve has to operate in the modeling equation, with Pd = Ps to give disturber /error in supply pressure. With remove function and block diagram the figure above such below will be easier.

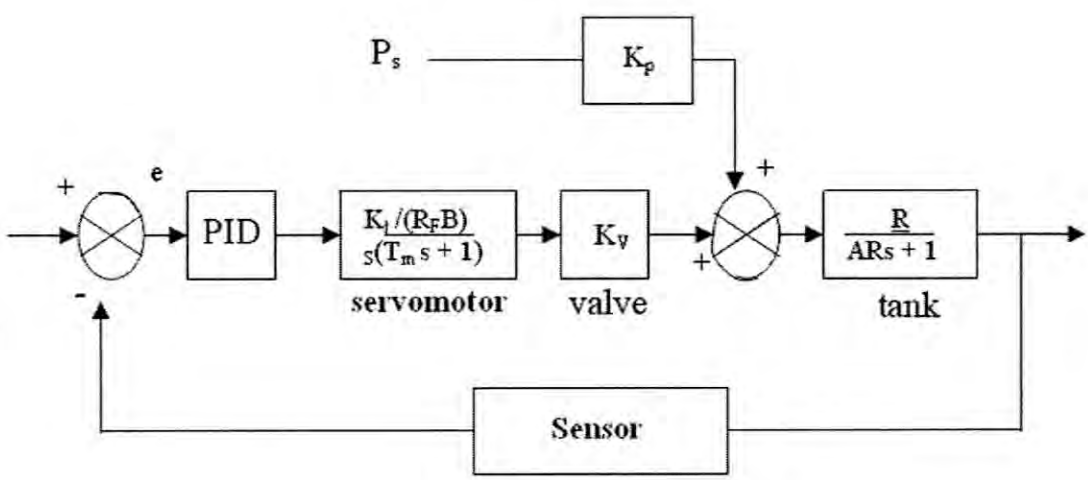

Figure 1.4 : Element of the block diagram of the System Water Tank Level Using PID Controller.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction of PID.

PID stands for Proportional, Integral, Derivative. Controllers are designed to eliminate the need for continuous operator attention. Cruise control in a car and a house thermostat are common examples of how controllers are used to automatically adjust some variable to hold the measurement (or process variable) at the set-point. The set-point is where you would like the measurement to be. Error is defined as the difference between set-point and measurement.

(error) = (set-point) - (measurement) The variable being adjusted is called the manipulated variable which usually is equal to the output of the controller. The output of PID controllers will change in response to a change in measurement or set-point. Manufacturers of PID controllers use different names to identify the three modes. These equations show the relationships:

P Proportional Band = 100/gain

I Integral = 1/reset (units of time)

D Derivative = rate = pre-act (units of time)

Depending on the manufacturer, integral or reset action is set in either time/repeat or repeat/time. One is just the reciprocal of the other. Note that manufacturers are not consistent and often use reset in units of time/repeat or integral in units of repeats/time. Derivative and rate are the same.

2.1 Proportional Band.

With proportional band, the controller output is proportional to the error or a change in measurement (depending on the controller).

(controller output) = (error)*100/(proportional band)

With a proportional controller offset (deviation from set-point) is present. Increasing the controller gain will make the loop go unstable. Integral action was included in controllers to eliminate this offset.

2.2 Integral.

With integral action, the controller output is proportional to the amount of time the error is present. Integral action eliminates offset.

CONTROLLER OUTPUT = (1/INTEGRAL) (Integral of) e(t) d(t)

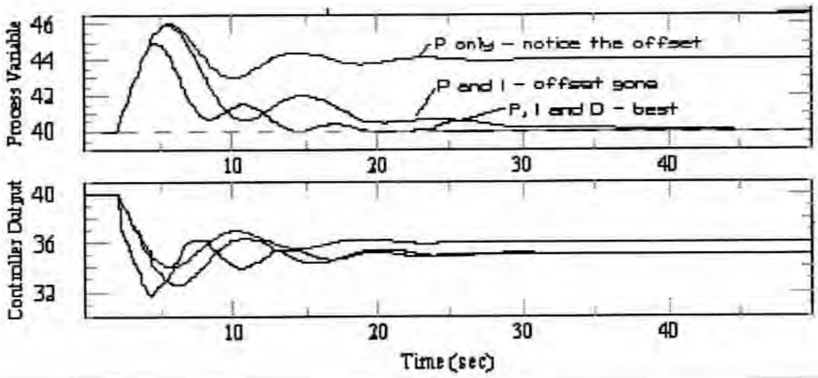

Figure 2.1 : Integral action eliminates offset.

Notice that the offset (deviation from set-point) in the time response plots is now gone. Integral action has eliminated the offset. The response is somewhat oscillatory and can be stabilized some by adding derivative action. (Graphic courtesy of Exper Tune Loop Simulator.)

Integral action gives the controller a large gain at low frequencies that results in eliminating offset and "beating down" load disturbances. The controller phase starts out at –90 degrees and increases to near 0 degrees at the break frequency. This additional phase lag is what you give up by adding integral action. Derivative action adds phase lead and is used to compensate for the lag introduced by integral action.