TEMPERATURE STABILIZER SYSTEM

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7 MEI 2007

"I hereby declare that I have read through this report and found that is sufficient in terms of scope and quality to be awarded of the Degree of Bachelor in Electrical Engineering (Industrial Power)"

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This Report Is Submitted In Partial Fulfillment Of Requirements For The Degree of Bachelor In Electrical Engineering (Control, Instrumentation and Automation)

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Universiti Teknikal Malaysia Melaka

Mei 2007

"I declare that this report is the result of my own research expect as cited in the references.

Signature :..
Name :Salmiah bt Nisa @ Maddin
Date : 7 MEI 2007

Dedicated to my beloved mother, Rokiah and all who helping me lots.

ACKNOWLEDGEMENT

It is with profound gratitude to Allah S.W.T that I now pen down a few words to express my gratitude. I would like to take opportunity here to give big credits to people who had made it possible for me to complete my final project.

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Thank You.

ABSTRACT

Temperature Stabilizer System is projects that use to stabilize the desired temperature in certain area. For this project, it is focus on tank (*especially fluid contain inside). The purposed of this system is to make sure the fluid temperature is not below or higher than the temperature that set by the operator (engineer) all the time. This project use both software and hardware components. For software, I use EX-Programmer rather than other software because it is easily to detect errors and easily to simulate the circuit. For hardware, the component includes temperature controller from Omron type (E5AK), Resistance Temperature Detector (RTD-PT100) small motor, contactors, MCB, timers, relays and etc. Temperature is set to a desire degree for example 250 degrees. The RTD will joint to the tank (contain with fluid) and sense the temperature's changing. When the temperature becomes below than the setting value, the warning light will indicates and the siren will sounds. This is to make sure the engineer notice about it and solve the problem. Blue indicator light will on to notice that there is a low temperature condition occur.

ABSTRAK

Temperature stabilizer system adalah satu projek yang digunakan untuk menyeimbangkan suhu yang diinginkan di dalam sesuatu kawasan. Namun begitu, untuk projek ini saya lebih menfokuskan kepada ruang yang lebih spesifik iaitu tangki (mengandungi cecair). Tujuan system ini adalah untuk memastikan suhu cecair adalah lebih tinggi daripada suhu yang ditetapkan oleh pihak yang tertentu (jurutera). Dalam projek ini saya menggunakan perisian dan juga komponen perkakasan. Bagi perisian, saya telah memilih untuk menggunakan program-EX (EX-programmer) berbanding program perisian yang lain kerana ia amat mudah untuk digunakan untuk mengesan kesilapan dan juga membuat simulasi. Bagi perkakasan pula, diantara komponen utama termasuk pengawal suhu (Omron E5AK), Pengesan Suhu Berperintang (RTD), motor, sesentuh, pemutus litar, geganti dan sebagainya. Suhu akan ditetapkan seperti yang diinginkan oleh industri sebagai contoh 250 darjah kepanasan. RTD akan disambungkan kepada tangki dan ianya akan mengesan sebarang perubahan suhu di dalam tangki. Apabila suhu didapati rendah daripada yang telah ditetapkan didalam pengawal suhu, lampu amaran akan menyala dan siren akan berbunyi. Ini adalah langkah yang pertama untuk memberi amaran kepada jurutera atau pekerja yang disekitar bahawa terdapat perubahan suhu yang kurang dari nilai yang ditetapkan. Lampu indikator warna biru akan menyala menandakan berlaku penurunan suhu dibawah paras tetapan (low tempearture). Motor tidak akan automatik hidup melainkan perubahan suhu mencatatkan bacaan yang melebihi suhu yang ditetapkan. Apabila suhu tinggi, lampu aamran akan menyala dan siren akan berbunyi serta motor akan dihidupkan secara automatik. Lampu indikator warna oren akan menyala menandakan berlaku keadaan suhu tinggi (high temperature

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In this chapter, I will bring in and explained briefly of my project that titled "Temperature Stabilizer System". The objectives and scopes are very important because it will guide the whole process and also gives the right way to discover of completing this project. A few literature reviews has been experimental to bear out clearly the problem statements of this project.

There are two major tasks in this project. It is designing and implementing task which really require high critical thinking. Both of the task is very important and have to be done successfully with proper progress.

This project is actually all regarding the control system. Temperature stabilizer system is use widely in factory where most of the machine and manufacturing equipment are very sensitive to the changing of the temperature. The suitable temperature level is very important as it can affect the product quality and maintenance schedule.

1.2 Project Title

In partial fulfillment of requirements for the Degree of Bachelor in Electrical Engineering (Control, Instrumentation and Automation), I have chosen to design and construct the Temperature Stabilizer System. This system is controlled by a controller (Omron E5AK) that will decide the motor to switch on or off. It will be turned on when there's an over value of the temperature setting and only off when the low temperature detected.

1.3 Problem Statements

Since this is a new project, it is normal to have several problems along the project progress. These problems actually can generate ideas to come out with desire result at the end of the project. There were several problems that I have faced in this project, which is listed below:

a) Designing the circuit diagram for the complete system.
b) Selecting the suitable components and part that should be use together.
c) Selecting the types of controller.
d) Writing the ladder diagram for the programming propose.
e) Simulating the software and evaluate the outcome.
f) Developing the hardware; assemble the hardware components and materials.
g) Setting, testing and troubleshooting.

1.4 Objectives

This project will be done successfully when the objectives of the project are state clearly. This is because it will be the guideline to develop this project step by step and the objectives of the project are:

a) To produce a high quality of product as suitable temperature applied to the certain item during the process.
b) To maintain the temperature at the certain value so that the engineer or technician can focus on other job.

c) To avoid human from being involve directly or all the time at the high risk plant or factory.

d) To prevent the sensitive equipment especially instrument equipment (sensor, inverter, capacitor etc) from serious damage affect from the high temperature (overheating).

1.5 Project Scopes

For this project, I will cover on learning and understanding all the basic function and every single parts of the system. I will design and build the automatic temperature system by using hardware and also software.

This automatic temperature stabilizer system is using PLC programming (CX-Programmer) to simulate and also a controller that act like a switch to on or off the motor. I had designed the program using PLC that has timer, relay, siren, warning light and indicator.

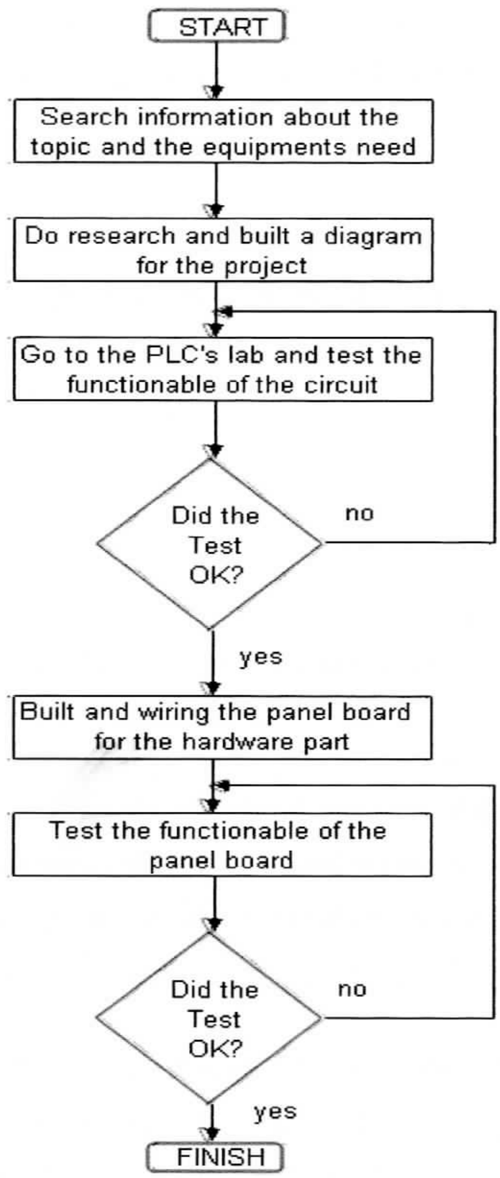
After I have been complete on my simulation programmed, which successfully done in PSM 1, then I continue to build the model of the temperature stabilizer system using hardware. The hardware parts consist of a controller as the main part, switching devices such as Miniature Circuit Breaker (MCB), selector switch, and etc.

The equipment for indicator also significant. For this project, I use siren, warning light (flashing), and indicator light to give a signal when there is a temperature vary occurs at that point.

For the main output, I use motor to drive the fan as a cooling segment during high temperature level. For this project, I only have a three phase motor that should be connected to the panel (single phase). I use inverter that use single phase input current to produce three phase current output that match with the motor.

After complete all the wiring, I setting the controller and test the operation of the panel and do some analysis to the output results.

1.6 Project Methodology



CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This project required literature review because it deals more on basic concepts and fundamental of the controller, switching devices, and even the automation system and the mechanism. Without knowing the very basic and the fundamental of this project, I cannot easily make a decision to choose to build this system.

With this literature review, it helps me a lot to analyze the result base on the characteristic of every equipment. Besides, with this literature review, I can gain extra knowledge and get more information about the equipment used.

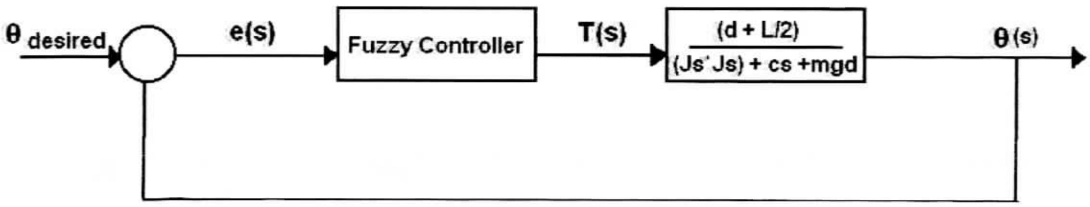
2.2 Controlled system

A control system is a device or set of devices to manage, command, direct or regulate the behavior of other devices or systems.

There are two common classes of control systems, with many variations and combinations such as logic or sequential controls, and feedback or linear controls. There is also fuzzy logic, which attempts to combine some of the design simplicity of logic with the utility of linear control. Some devices or systems are inherently not controllable.

The term "control system" may be applied to the essentially manual controls that allow an operator to, for example, close and open a hydraulic press, where the logic requires that it cannot be moved unless safety guards are in place.

An automatic sequential control system may trigger a series of mechanical actuators in the correct sequence to perform a task. For example various electric and pneumatic transducers may fold and glue a cardboard box, fill it with product and then seal it in an automatic packaging machine.



In the case of linear feedback systems, a control loop, including sensors, control algorithms and actuators, is arranged in such a fashion as to try to regulate a variable at a set point or reference value. An example of this may increase the fuel supply to a furnace when a measured temperature drops.

PID controllers are common and effective in cases such as this. Control systems that include some sensing of the results they are trying to achieve are making use of feedback and so can, to some extent, adapt to varying circumstances. Open-loop control systems do not directly make use of feedback, but run only in pre-arranged ways.

2.2.0 Logic controls

Pure logic controls were historically implemented by electricians with networks of relays, and designed with a notation called ladder logic. Nowadays, most such systems are constructed with programmable logic controllers.

Logic controllers may respond to switches, light sensors, pressure switches etc and cause the machinery to perform some operation. Logic systems are used to sequence mechanical operations in many applications. Examples include elevators, washing machines and other systems with interrelated stop-go operations.

Logic systems are quite easy to design, and can handle very complex operations. Some aspects of logic system design make use of Boolean logic.

2.2.1 Linear controls

Linear controls use negative feedback to keep some desired process within an acceptable operating range.

2.2.2 Non-linear control systems

Processes in industries like robotics and the aerospace industry typically have strong non-linear dynamics. In control theory it is sometimes possible to linearism such classes of systems and apply linear techniques: but in many cases it can be necessary to devise from scratch theories permitting control of non-linear systems.

These normally take advantage of results based on Lyapunov's theory. Differential geometry has been widely used as a tool for generalizing well-known linear control concepts to the non-linear case, as well as showing the subtleties that make it a more challenging problem.

2.2.3 On-off control

For example, a thermostat is a simple negative-feedback control when the temperature (the 'measured variable' or MV) goes below a set point (SP), the heater is switched on. Another example could be a pressure-switch on an air compressor: when the pressure (MV) drops below the threshold (SP), the pump is powered. Refrigerators and vacuum pumps contain similar mechanisms operating in reverse, but still providing negative feedback to correct errors.

Simple on-off feedback control systems like these are cheap and effective. In some cases, like the simple compressor example, they may represent a good design choice.

In most applications of on-off feedback control, some consideration needs to be given to other costs, such as wear and tear of control valves and maybe other start-up costs when power is reapplied each time the MV drops. Therefore, practical on-off control systems have a dead band, a region around the set point value in which no control action occurs. The width of dead band may be adjustable or programmable.

2.2.3 Proportional control

When controlling the temperature of an industrial furnace, it is usually better to control the opening of the fuel valve in proportion to the current needs of the furnace. This helps avoid thermal shocks and applies heat more effectively.

Proportional negative-feedback systems are based on the difference between the required (SP) and measured (MV) value of the controlled variable. This difference is called the *error*. Power is applied in direct proportion to the current measured error, in the correct sense so as to tend to reduce the error (and so avoid positive feedback). The amount of corrective action that is applied for a given error is set by the gain or sensitivity of the control system.

At low gains, only a small corrective action is applied when errors are detected: the system may be safe and stable, but may be sluggish in response to changing conditions; errors will remain uncorrected for relatively long periods of time: it is over-damped. If the proportional gain is increased, such systems become more responsive and errors are dealt with more quickly. There is an optimal value for the gain setting when the overall system is said to be critically damped. Increases in loop gain beyond this point will lead to oscillations in the MV; such a system is under-damped.

2.2.4 Under-damped furnace example

In the furnace example, suppose the temperature is increasing towards a set point at which, say, 50% of the available power will be required for steady-state. At low temperatures, 100% of available power is applied.

When the MV is within, say 10°C of the SP the heat input begins to be reduced by the proportional controller. (Note that this implies a 20°C 'proportional band' (PB) from full to no power input, evenly spread around the set point value). At the set point the controller will be applying 50% power as required, but stray stored heat within the heater sub-system and in the walls of the furnace will keep the measured temperature rising beyond what is required.

At 10°C above SP, we reach the top of the proportional band (PB) and no power is applied, but the temperature may continue to rise even further before beginning to fall back. Eventually as the MV falls back into the PB, heat is applied again, but now the heater and the furnace walls are too cool and the temperature falls too low before its fall is arrested, so that the oscillations continue.