CONTROL SYSTEM FOR TEMPERATURE COOLANT IN AN OIL TANK

PREMADASAN S/O RAMAN

18 NOVEMBER 2005

" Saya/Kami akui bahawa saya telah membeca karya ini pada pandangan saya/kami karya ini adalah memadai dari skop dan kualiti untuk tujuan penanugerahan ijazah Sarjana Muda Kejuruteraan Elektrik (Kuasa Industri)."

Tandatangan : ____________________

Nama Penyelia : Prof.Dr. Mohammad Rohmanudin

Tarikh : 18 November 2005

CONTROL SYSTEM FOR TEMPERATURE COOLANT IN AN OIL TANK

PREMADASAN S/O RAMAN

This Report Is Submitted In Partial Fulfillment of Requirements For
The Degree of Bachelor in Electrical Engineering (Industry Power)

Fakulti Kejuruteraan Elektrik
Kolej Universiti Teknikal Kebangsaan Malaysia

November 2005

I hereby verify that this paper work is done on my own except for the references I made which I have stated the sources clearly on the specified section. [1-13]

Sign : ____________________

Name : PREMADASAN S/O RAMAN

Date : 18 NOVEMBER 2005

AKNOWLEDGEMENT

I would like to take this opportunity to thank my project supervisor, Prof.Dr. Mohammad Rohmanudin, who had provide me support and editorial advise in preparation of this report. A very sincere thanks is forwarded to the Electrical Faculty which plays a major role preparing students with handful knowledge and skills.

Also not forgetting, my grateful thanks is extended to my beloved parents, course mates and other friends for providing me support, advice, love and affection in preparation of this project.

ABSTRACT

The whole concept of this project is to build control system for temperature coolant in an oil tank. The construction would be based on the adapting idea from the similar system with fully machine which are used in local industries. This control system will be targeted for the medium and heavy industries while marketing it with cheaper cost. Basically, the proposed system will be integrated with mechanical part, electronic units and electrical unit to make it as one control system. As a result the system would be complex free as the Logic Gates replaces the necessary sequential relay circuit for the pump motor control. The operation of the system may not suite all the industries because some industry not using coolant to their process and it may need some adjustment. This adjustment can be overcome according to the requirement wanted by doing some editing on the system. Actually the system works to maintain the temperature of the coolant in expected range and the level of the coolant. The purpose of the temperature to be maintain is to overcome the problem of sediment in flowing to process. This ac pump motor is incapable of pulling the water when relay activate and motor run while the operation of the motor is terminated. A magnetically coupled pump would be more convenient when building a tank system. A magnetically coupled pump is one where the motor drives the impeller of the pump through the interaction of magnets. This allows for the pump head to be totally isolated from the motor shaft so that the liquid never comes into contact with the motor, which is beneficial for obvious sanitary reasons.

ABSTRAK

Konsep utama projek Sarjana Muda adalah cadangan untuk membina satu system pengawalan suhu untuk bendalir penyejuk dalam tangki yang berkebolehan berfungsi secara automatik. Pembinaan sistem ini adalah hasil daripada sebuah sistem yang sedia ada di sebahagian kilang industri dan di pasaran. Sistem ini disarankan untuk kegunaan industri serdehana dan berat dengan penawaran harga yang minimum. Keseluruhan sistem ini merangkumi bahagian mekanikal, unit elektronik dan juga bahagian elektrikal. Di samping itu juga kompleksiti dapat dikurangkan dari segi pembinaan. Pengoperasian sistem ini tidak begitu sesuai kepada semua industri-industri yang tidak menggunakan bendalir penyejuk dalam pemprosesan. Malah kaedahnya masih boleh digunakan dengan membuat sedikit perubahan pada sistem ini. Sistem ini beroperasi untuk mengawal tahap suhu bendalir penyejuk dalam tangki dan tahap minimum dan maksimum bendalir penyejuk dalam tangki. Tujuan pengawalan suhu bendalir penyejuk dalam tangki supaya kandungan bendalir tidak menyebabkan mendakan dalam sistem penghantaran ke proses. Penggunaan motor ac satu fasa tidak begitu jitu apabila relay diaktifkan dan arus mengalir walaupun tidak ada beban dan kuasa yang dilesapkan adalah rendah. Maka penggunaan motor "magnetically coupled pump" yang tepat dengan kehendak industri perlu dipertimbangkan dalam projek ini.

TABLE OF CONTENT

LIST OF FIGURES

LIST OF APPENDIX

CHAPTER 1

INTRODUCTION

1.1 Background of the system

A system comprises a complex combination of resources (in the form of human beings, materials, equipment, software, facilities, data, information, services, etc.) integrated in such manner to fulfill a designated need. A system is developed to accomplish a specific function, or a series of functions, and maybe classified as a natural system, human-made system, physical system, conceptual system, closed loop system, static system, and dynamic system and so on.

The system in general addresses to identify the need for and the basic requirements for initially bringing systems into being and for later evaluating systems in terms of their effectiveness in a user's environment. In fact in recent years and for many systems, there has been an imbalance between the cost side of the spectrum and the effectiveness side. Many systems have grown in complexity, and although there has been an increase in emphasis in some performance factors, the resultant reliability and quality have been decreasing. At the same time, the overall long time cost has been increasing. Thus, there is a need to provide a proper balance in the development of system in the future, as any specific design decision will have an impact on both sides of the balance and the interaction effect can significant.[5]

A highly disciplined approach must be pursued in the design and the development of new system, with the objective providing the customer (user) with a quality system that is cost-effective, considering the proper balance among the factors identified.

In an undergraduate project, I have installed six stations for data acquisition and control system. Each station is connected to a specific piece of engineering apparatus which contains sensors and control elements.

The objective for the stations in the project is to give a physical system which its could see, hear and touch as they carried out project in control system identification and controller design. Each system contains the apparatus called the "engineering system" and the hardware and software called the "controller." These parts fit into a control scheme that is depicted in the diagram below (Figure 1).

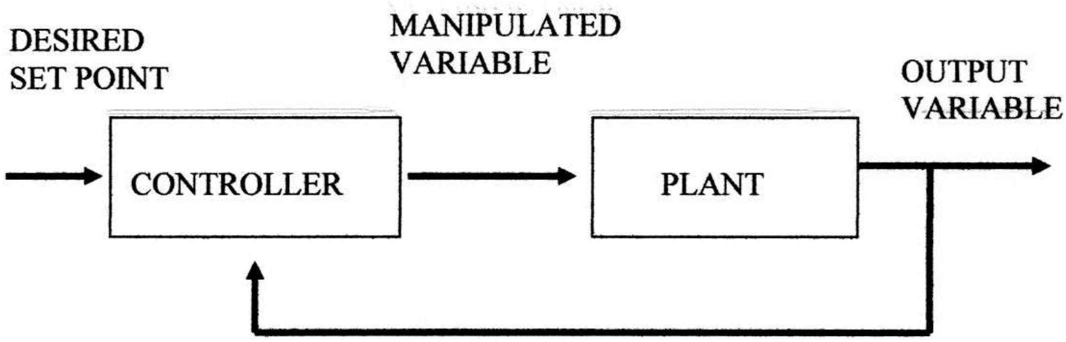

Figure 1. System diagram

All the engineering systems are inherently stable, two-input, two-output systems. They are non-linear and at least one is time-varying. All controllers are implemented on digital gates. The analysis and design in this project is done with the assumption that the controllers are continuous signal controllers. The digital logic gates sampling time is fast enough (faster than the typical engineering system response) to make this assumption valid.

In the course of the undergraduate, students (as operators of the equipment) are to conduct the project to determine the steady-state and dynamic characteristics of their engineering system and then tune the parameters of the controller to achieve appropriately controlled behavior of the closed-loop, feedback-controlled system.[11]

The plant are :

(1) speed control on a motor-fan rotating electric

(2) water mass flow rate control in a pump & pipe system

(3) position control of a cart on a track

(4) water level control in a pair of interconnected tanks

(5) temperature control in a heat exchanger.

Specific details of these systems are in the Appendix. The rest of this paper describes how the systems are used.

1.2 Objective of the project

There are some objective on doing this project to reach the target, that are:

1. To control the temperature of the coolant in between the setting range according to the manufacturing.
2. To control the level of the coolant inside the tank to be in permissible range
3. Design and integrate the control circuit with the control system
4. To build the prototype model according to the control system

1.3 Scope of Project

Scope of this project is to build the system where to overcome the problem which faced by the most of industries today regarding the usage of coolant in process needs some major maintenance. There are,

1. When the coolant used in industries are in cold temperature, the ingredients inside the coolant make have the sediment at the bottom part. This made the blockage in the process supply hose whenever the coolant are needed.
2. The level of the coolant in the tank may in beyond permissible range

CHAPTER 2

THEORETICAL BACKGROUND

There are many types of temperature control system in tanks available on the world market. One type of temperature control system in tank method may fit certain applications better than others. Conversely, some temperature control system methods are not suited for some applications at all and will result in wasted investment. It is therefore important that your temperature control system in tank supplier can offer you a wide range of system types with the greatest amount of flexibility to meet your specific product flowing needs.

Likewise the Dion Hollenbeck and Evan Kraus produces various types of temperature control system in tank to market it according the users environment. The types of temperature control system for tank available are for Food & Beverages, Chemical, Pharmaceutical and some solid products. To be specific for the review we will take note some of the temperature control system in tank for liquid products.[10]

Dion Hollenbeck and Evan Kraus can provide RIMS brewing system to flow the heated liquid and semi-liquid products into productions. RIMS brewing system, which is a two-tier / three-vessel system with the RIMS located in the middle. The frame is constructed of wooden 2x4's that are bolted together using 2-1/2" to 3" long bolts and screws (you don't want this thing wabbling under the weight of full boiling kettles). The frame legs have wheels that can be locked down in place once I roll it out from the garage. From left to right you can see the boiling kettle, the mash/lauter tun (with insulation), and the hot water tank elevated above the other tanks to allow for gravity flow. The large vertical copper pipe to the right of the mash tun houses the heating element. The grey box at the bottom of the heating element piping is a water-proof GFCI-outlet housing where everything plugs in. The silver box to the right of that is an old computer power supply box that houses my new PID temperature controller. The pump is located below the center mash tun and is mostly hidden by the framework. The two vertical poles on the two end kettles are liquid level sighting glasses.

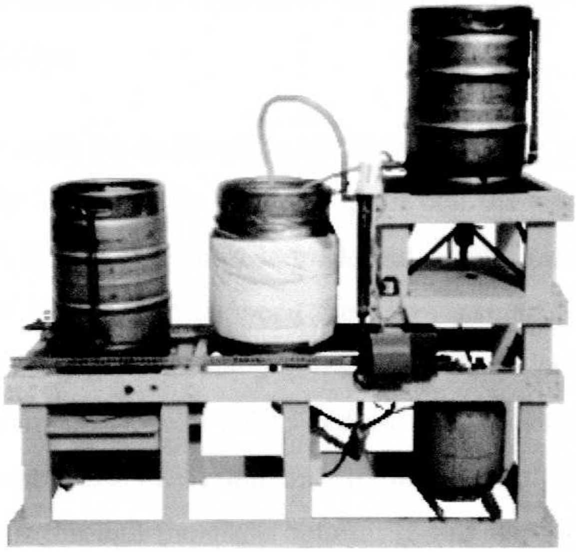

Figure 2.1: RIMS brewing system

There are many other setups that can use besides this, so use imagination. Some people have their entire system gravity fed (three-tier), others have all vessels on the same level (usually requires an additional pump), and some use only two vessels with one doing double-duty as both the hot water tank and the boiling kettle. Other ideas include using only one propane burner that is mounted so that is can slide back-and-forth under the appropriate kettle.

Here can see mash tun is well insulated. It wrapped with insulation purchased from a hardware store that is made for hot water heaters. Cut a hole in the top of the lid of a plastic bucket to further reduce the heat loss to the atmosphere. The better insulate, the less your heating element will have to work.

The silver colored tubing is connected the the elevated hot water tank to the right. Use this only when mixing hot water with the freshly crushed grains (doughing-in) and when sparging. Otherwise, it is folded out of the way. Also notice in the lower right corner the red handle of the ball valve that use to control the flow rate during circulation.

Once the mash tun is complete, the false bottom is constructed and placed in the bottom of the mash tun to hold the grain bed up while allowing the wort to circulate through it. False bottom is made out of two pizza oven screens with an aluminum screen sandwiched between the pizza screens. These pizza screens are made of rigid aluminum. This setup gives a very large percent-open-area for false bottom, which is important for a RIMS system. If false bottom does not have a large enough percent-open-area, then pump may try to pump the wort at a rate faster than it can naturally flow through the false bottom. If this happens then the pump might create a suction below the grain bed that is strong. enough to cause the grain bed to compact and thus restrict even further the rate of recirculation.

After the wort flows out of the mash tun, down through the false bottom, and through the pump, it then travels into the heating chamber. The large copper vertical pipe in the center of this photo(figure 2.2) is 1.5" in diameter which houses the heating element that is used to maintain mashing temperatures. At the top can see a large dial bi-metal thermometer that I use to verify the temperature readout of the PID controller (redundant and probably unnecessary) and also a plastic cup that covers the exposed wires of the heating element. Near the bottom are two boxes. The grey one is simply a water-protection cover for the outlets where plug everything in.

The metallic box to the right of this grey one houses the PID temperature controller, the brains of this outfit! About midway up to the right of the copper heating chamber is a small black device.

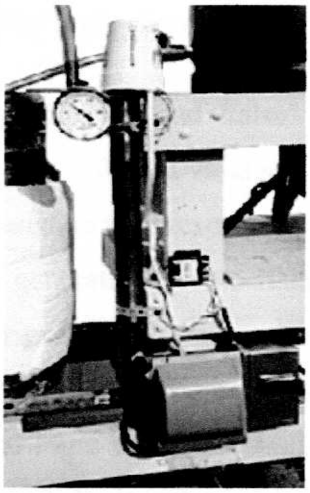

Figure 2.2: Bi-Metal thermometer

2.1 Different Technique and Comparison Between the Project

Basically, there are different kinds of technique used to construct the temperature control system in tank mechanism. In the vast changing technology, each manufacturer complete in making a system which compromise latest equipment.

This equipment which has its own configures reliability and functions advantages actually increased the system complexity. The system life cycle will be a question mark as the constantly changing requirement because of the dynamic condition worldwide.

Expertise assistance is needed to handle the systems with care and also a frequent service is required to maintain the system function reliability.

2.2 Functions performed by logic circuits

"True" can be represented by a 1 and "false" by a 0, and in logic circuits the numerals appear as signals of two different voltages. Logic circuits are used to make specific true-false decisions based on the presence of multiple true-false signals at the inputs. The signals may be generated by mechanical switches or by solid-state transducers. Once the input signal has been accepted and conditioned (to remove unwanted electrical signals, or "noise"), it is processed by the digital logic circuits. The various families of digital logic devices, usually integrated circuits, perform a variety of logic functions through logic gates, including "OR,""AND," and "NOT," and combinations of these (such as "NOR," which includes both OR and NOT).[13]

2.2.1 Types of Logic Components

One widely used logic family is the transistor-transistor logic (TTL). Another family is the complementary metal oxide semiconductor logic (CMOS), which performs similar functions at very low power levels but at slightly lower operating speeds. Several other, less popular families of logic circuits exist, including the currently obsolete resistor-transistor logic (RTL) and the emitter coupled logic (ELC), the latter used for very-high-speed systems.

Logic gates are an important building block of a digital circuit, which are employed in all of our modern computers. The microchips of computers are arranged in thousands of logical gates, which make precise and consistently reliable conclusions. There are no limits in the amount of gates that can be used and with the advancement of microchip technology; we can constantly add more gates to newer chips. There are eight main logic gates, which can be divided into two main subgroups: non-inverted and inverted which gives the exact opposite answer of the non-inverted. There are four logic gates in each subgroup and as mentioned before, eight basic logic gates and with these many complex operations can be performed. These eight gates are (put links on each word) Buffer, AND, OR, EOR, NOT, NAND, NOR, ENOR. Six of these eight logic gates contain two inputs and all the basic logic gates contain one output. All logic gates have two conditions that are represented by binary numbers and different voltages. The binary number zero and a voltage of zero represent the off or low switch and the binary number one and a voltage of five represent the on or high switch. Theses gates allow the computer to do things such as add, divide, multiply, do simple yes and no reasoning in certain situations along with other things.

CHAPTER 3

DESIGN METHODOLOGY

3.1 Some Reason Behind The Project

The proposed system of "control system for coolant temperature in oil tank "is design according to the environment it will be in use. Although individual perception will differ, depending on what various people observe, there are number of trends that appear to be significant. Those are: [2]

- ***Constantly changing requirements***: The requirement for the new system are frequently changing because of the dynamic conditions worldwide, changes in mission, thrusts and priorities, and the continues introduction of the new technologies.

- ***More emphasis on 'system'***: This is greater emphasis on the total system versus the components of the system. One must look at the system "in total," and throughout its entire life cycle, to ensure that the functions that need to be performed are being accomplished in an effective and efficient manner.

- ***Increasing system complexity***: It appears that the structures of many systems are becoming more complex with the introduction of evolving new technologies. It will be necessary to design system so that changes can be incorporated quickly, effectively, and without causing a significant impact on the configuration of the system.

- ***Extended system life cycle:*** The life cycle of many of the systems in use today are being extended for one reasons or another while, at the same time, the life cycle of most technologies are relatively much shorter. It will be necessary to design systems with an open architecture approach in mind so that the incorporation of the new technology can be accomplished easily and efficiently.

- ***Greater utilization of commercial off-the shelf(COTS) product:*** With current goal pertaining to lower initial cot and shorter and more efficient procurement and acquisition cycle, there have been greater emphasis on the utilization of the best commercial practice, processes, and commercial off-the-shelf (COTS) equipment and software. As a result, there is a greater need for a good definition of requirements from the beginning, and there is a greater emphasis on the design of system.

3.2 A Problem Solving Methodology

A problem solving methodology that is useful in design consists of the following steps:

- Definition of the problem
- Gathering of information
- Generation of alternative solutions

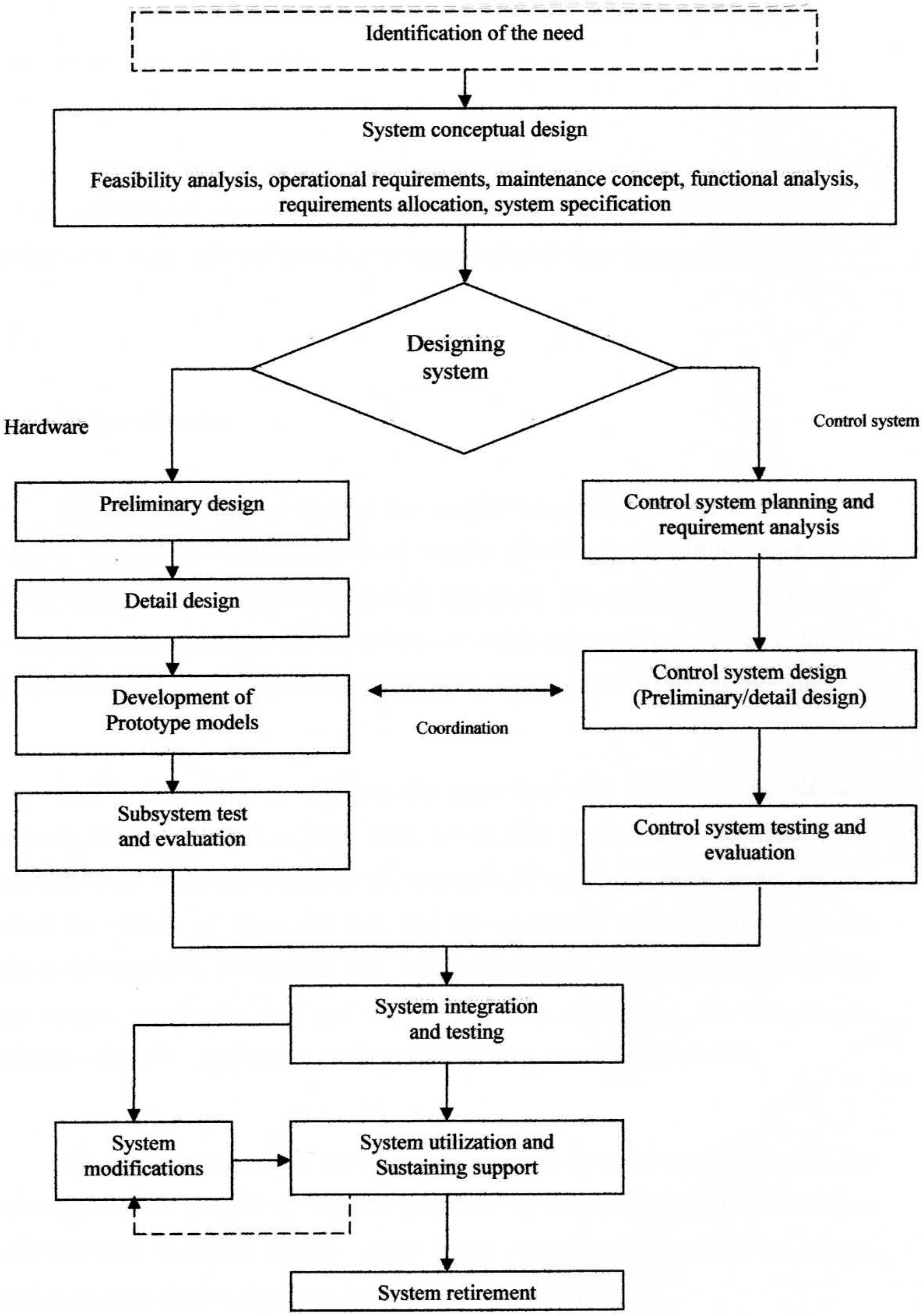

Figure 3.1: Problem Solving Methodology