UNIVERSITI TEKNIKAL MALAYSIA MELAKA

CONTROL SYSTEM DESIGN FOR TEMPERATURE ALERT SYSTEM

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotic and automation) with Honours

by

NOOR HISHAM BIN MOHAMAD SAID

B050810184

FACULTY OF MANUFACTURING ENGINEERING

2011

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PSM

TAJUK: **Control System Design for Temperature Alert System**

SESI PENGAJIAN: **2010/11 Semester 2**

Saya **NOOR HISHAM BIN MOHAMAD SAID**

mengaku membenarkan tesis (PSM/Sarjana/Doktor Falsafah) ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. *Sila tandakan (√)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☐	TIDAK TERHAD	

Disahkan oleh:

_____ (TANDATANGAN PENULIS)

_____ (TANDATANGAN PENYELIA)

Alamat Tetap:
NO 15 JALAN DR 2,
TAMAN DUYONG RIA
75460 MELAKA,
MELAKA.

Cop Rasmi:

Tarikh: _____

Tarikh: _____

* Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby declare that this report entitled **"**Control System Design for Temperature Alert System**"** is the result of my own research except as cited in the references.

Signature	:	
Author's Name	:	Noor Hisham bin Mohamad Said
Date	:	19 MAY 2011

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree in Bachelor of Manufacturing Engineering (Robotic and Automation). The members of the supervisory committee are as follow:

……

(Madam Nur Aidawaty Binti Rafan)

Main Supervisor

Faculty of manufacturing Engineering

ABSTRAK

Dalam sistem kejuruteraan suhu merupakan pembolehubah fizikal yang perlu dipantau dan dikawal. Sebagai contoh, sensor suhu digunakan di gedung-gedung, kilang pemprosesan kimia, mesin, komputer, kenderaan, dan lain-lain. Suhu yang amat tinggi boleh merosakkan kualiti dalam sesuatu sistem, sedangkan suhu rendah pula menyebabkan pembakaran dalam masa yang lama. Dengan meningkatkan kualiti sistem kawalan boleh mengawal suhu dengan mencapai bacaan yang memuaskan. Projek ini lebih tertumpu kepada sistem kawalan reka bentuk dengan menggunakan simulasi pada perisian MATLAB. Kaedah yang digunakan adalah berdasarkan rekaan pengawal PID, yang meningkatkan konsisten ralat dan tindak balas sementara secara bebas. Projek ini juga melibatkan analisis unsur-unsur sistem kawalan dengan membezakan nilai konsisten ralat dan tindak balas sementara (masa puncak, masa naik, masa penetapan) hasil daripada graf simulasi daripada input unit langkah untuk pampasan dan terpampas sistem. Satu daripada objektif reka bentuk sistem kawalan adalah proses penstabilan oleh itu, analisis sistem diteruskan dalam istilah kestabilan supaya mencapai objektif dengan mencari julat (K) supaya sistem itu akan beroperasi samada system stabil, tidak stabil atau hampir-hampir stabil supaya proses yang dilakukan akan beroperasi dalam keadaan yang sebaik mungkin

ABSTRACT

In many engineering systems temperature constitutes an important physical variable that needs to be monitored and controlled. For example, temperature sensors are present in buildings, chemical processing plants, engines, computers, vehicles, etc. A very high temperature may destroy the qualities of the some system, while a low temperature may result in long burning time. By enhancing quality of control system can make the controlled temperature reach a satisfactory point. This project will focus primarily on the design control system by using simulation on MATLAB software. The method is based on the designing the PID controller, which improving the steady-state error and transient response independently. This project also involves analysis the elements of control system by differentiate the value of steady-state error and the transient response (peak time, rise time, settling time) from the simulation graft of unit step input for the uncompensated and compensated system. The one objective of control system design is process stabilization so that the analysis of the system will continue in term of stability to achieved the objective by finding the range of the gain (K) in the systems so that, the system will operate either stable, unstable or marginally stable in order to processes operates in the best possible way.

DEDICATION

I dedicate this PSM thesis to my beloved parents, my lovely brothers and sisters, friends and colleagues, not forgot UTeM's lecturers.

ACKNOWLEDGEMENT

In the name of Allah, invocation and greetings to adoration of Nabi Muhammad (S.A.W.), thanks to God because giving me strength and patience in finishing this final year project and thesis writing on time. Alhamdulillah. Firstly I would like to express my appreciation to my supervisor Puan Nur Aidawaty Rafan for her guidance, advice and continuous encouragement in process of completing my project successfully. Besides that, a lot of cooperation to all staff and officer at Manufacturing Lab that help me had done my experiment. I would also want to express my thankfulness to my beloved parents for never ending support, advice and encouragement since childhood until now. May your love and support will never be gone until the end of my life. For UTeM's lecturers who have taught me, thank you for giving me precious and valuable knowledge. For my friends and my classmates, thanks for your cooperation, support and help throughout these 3 years in UTeM. Thank you so much.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

PC	-	Personal Computer
RTD	-	Resistance Temperature Detector
PID	-	Proportional Integrated Derivative
PD	-	Proportional Derivative
PI	-	Proportional Integral
DC	-	Direct Current
AC	-	Alternative Current
VB	-	Visual Basic
GUI	-	Graphical User Interface
I/O	-	Input Output
CPU	-	Central Processing Unit
CU	-	Control Unit
PWM	-	Pulse Width Modulator
IEEE	-	The Institute of Electrical and Electronic Engineers
ADC	-	Analog Digital Computer
CEB	-	Car Engine Block

CHAPTER 1
INTRODUCTION

1.1 Background

Temperature control is an important issue in many industrial processes, e.g., electric-resistance furnaces, crystal ovens, and heating boilers/tanks/barrels for various chemical and metallic products. Such a thermal process usually shows an integrating response characteristic during the heating stage, and after rising up to the set-point temperature, it tends to behave in a stable manner given a certain heating range, due to air convection or radiation loss into the environment. The main control challenges for such processes are to avoid overheating (i.e., temperature overshoot) in the heating stage and to tightly maintain the set-point temperature against load disturbances and process/environmental variations. Furthermore, thermal processes typically have slow time constants and long time delay, causing difficulties to control-system design. (Stanley M.Shinners, 1998)

The design procedure for designing a control system is an orderly sequence of steps. Good engineering design is interdisciplinary and requires that the engineer first thoroughly understand the customer's requirements, the defined control system specifications, the environment that the control system will operate in, the available power, the schedule that it must be built in, and the available budget to do the job. Other considerations are reliability and maintainability which may dictate the kind of motor to use (i.e., electric motor or hydraulic motor). (Stanley M.Shinners, 1998)

The general control system as shown in figure 1.1 can be divided into the controller and the machine. The controller can be divided into the control laws and the power converter. The machine may be temperature bath, a motor, or as in the case of a power supply, an inductor/capacitor circuit. The machine can also be divided in two: the plant and the feedback device(s). The plant receives two types of signals: a controller output from the power converter and the one or more disturbances. Simply put, the goal of the control system is to drive the plant in response to the command while overcoming disturbance. (George Ellis, 2000)

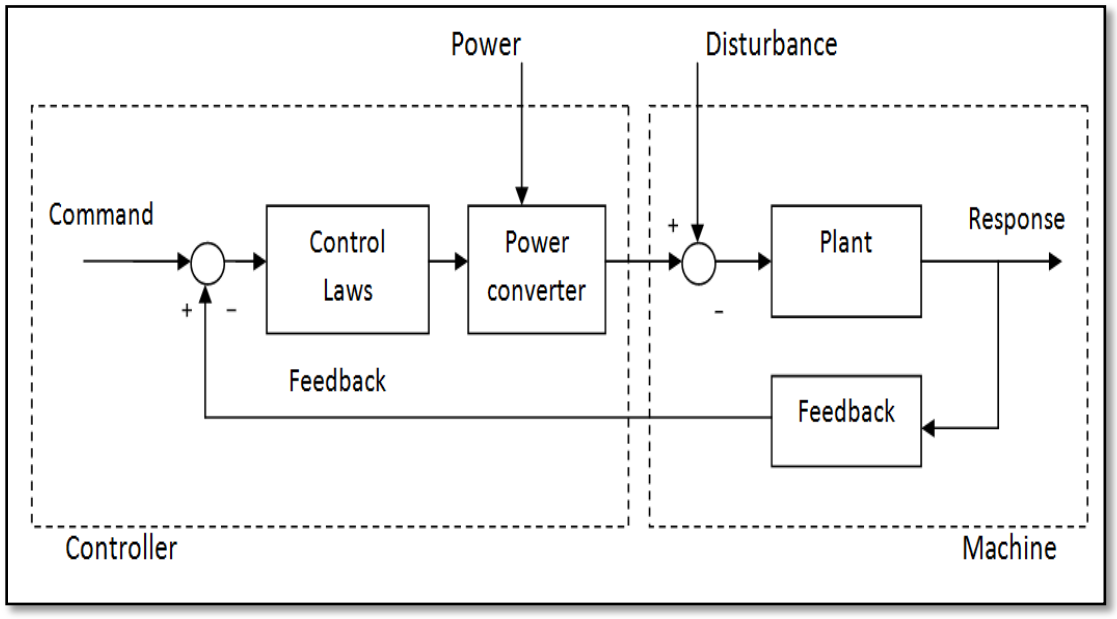

Figure 1.1: The General Control System (George Ellis, 2000)

1.2 Problem Statement

The most important parameter of some system is the temperature. For example, the Catalyst regeneration process regenerates the catalyst of a chemical reactor. An important variable, which is to be controlled, is the temperature of catalyst bed. A very high temperature may destroy the qualities of the catalyst, while a low temperature may result in long burning time. So, when the control system elements are introduced, the system become more stable by maintaining the temperature reaches a satisfactory point.

Temperature is one of the most frequently used parameters in process measurements in industry. There are many controllers can be used and one of the controller is PID. Mostly heater using an on-off method of it was the simplest form on control. When the heater is hotter than the set point temperature the heater is switch off completely. Based on this method, the temperature is fluctuate and caused the temperature is not constant. So based on this problem PID method has been used. PID controller provides a close loop concept in system. This close loop system will ensure that there is no error at the output. It will fix the error in order to reach the set point value. Three terms in this controller will provide a good performance for the output. Each of this term has its own contribution for the system. When these three terms is combining, the system will perform more efficient and precise.

Once the system reached operating temperature, all we worried about was overheating. Computers used to control system performance through all stages of temperature, maintaining time constant and stability of system, sensitivity, accuracy and transient response. When using PID controller, user can be easily tuning according to the system requirement. Tuning is important in order to achieved good performance of the system. If problem occurred or the system requirement change, user can set the new tuning easy and faster.

1.3 Project Objective

i. Design the PID controller of Temperature Control System using the simulation in MATLAB software according to the system requirement.
ii. Reduce the steady-state error of the system.
iii. Analysis the performance of designed control system such as the stability of the system by adjusting the gain, K either the system is stable, unstable or marginally stable.

1.4 Project Scope

This project will focus primarily on the design control system, so that processes operate in the best possible way. Generally, complete control system may have controller and machine. The controller will be used for this project is PID system that improves the steady-state error and transient response independently. Then differentiate the steady-state error for the uncompensated and compensated system for each process.

Once the PID controller are completely design, derive a proportional term, an integration term and a derivative term from the resulting transfer function of the PID compensator.

The improvements are focused on devising a new control technique that improves the system behavior against any kind of disturbances by study the performance which greatly improved the stability and control accuracy of the Temperature Alert System. The performance of a control generally specified in terms of stability, steady-state error and transient response.

1.5 Project Planning

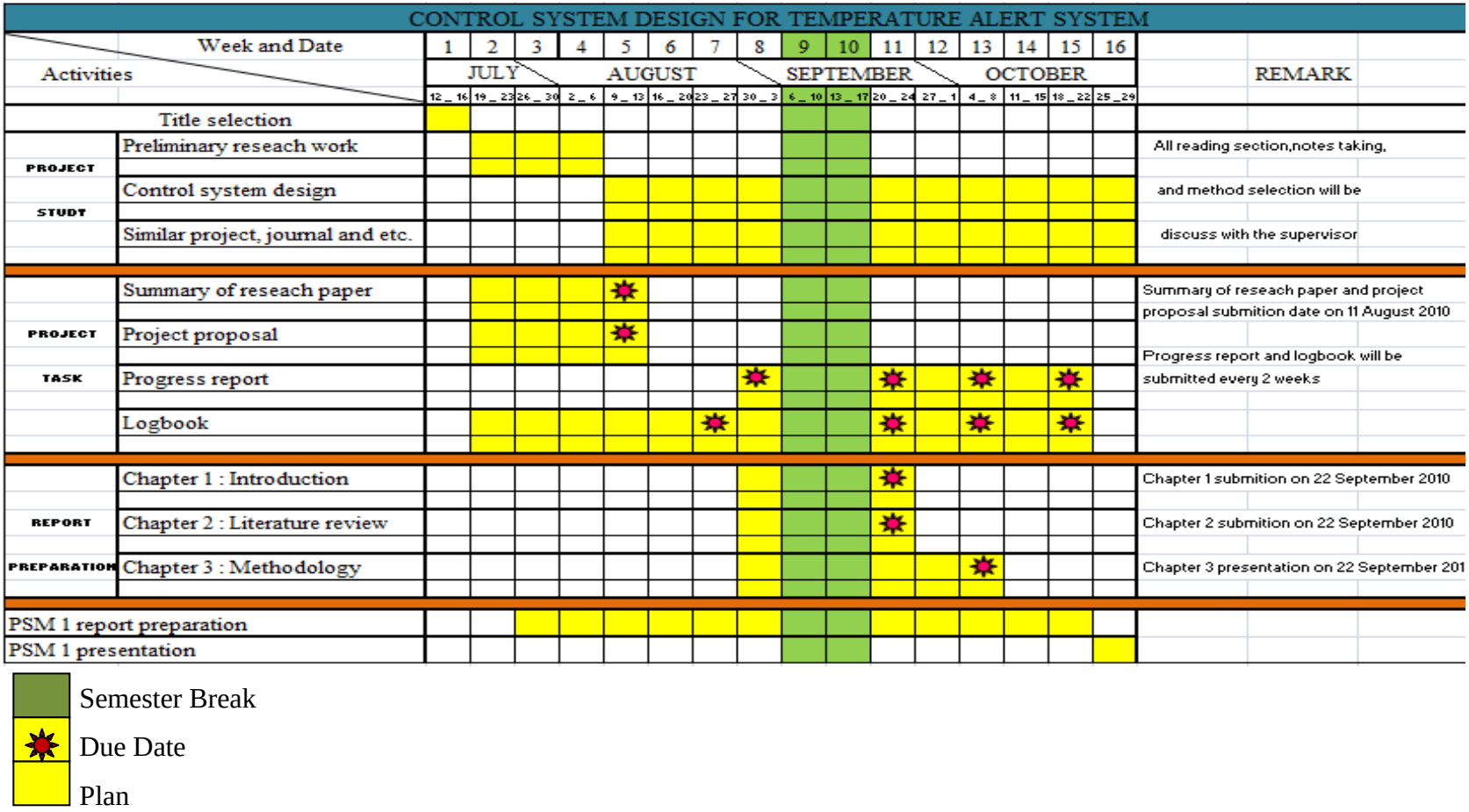

Figure 1.2: Gantt chart for PSM 1