

SMART POWER SAVER USING PID CONTROL BASED ON PLC APPLICATION

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A project report submitted in partial fulfilment of the  
requirements for the award of the degree of  
Master of Engineering  
(Electrical-Mechatronic and Automatic Control)

Faculty of Electrical Engineering  
Universiti Teknologi Malaysia

JUNE 2015

To my beloved husband and son,

To my beloved parents,

To my beloved siblings,

All my friends, colleagues and relatives.

Thank you for their support and always standing behind me.

## ACKNOWLEDGEMENT

Alhamdulillah, thanks to Allah S.W.T the most Merciful, for giving me the patience to completing this project.

I would like to take this golden opportunity to express my appreciation and heartfelt gratitude to Dr. Mohd Ridzuan Bin Ahmad as my supervisor and coordinator, for his guidance, encouragement and help.

I would also like to express special thanks to all my lecturers and all administrative staffs for their valuable information, various suggestions in improving the project and their cooperation towards the success of this project.

Last but not least, my special thanks to those who have directly or indirectly contributed to the success of this project.

## ABSTRACT

The changes in lifestyle to modern living allow consumer to use more sophisticated electrical appliance to suit their needs. The technology that involved in electrical engineering appliances has developed so rapidly to meet the customer demand. Consumer finds difficulty to control usage of appliances with high energy consumption .This project present a smart power saving and control system for the household electric power application. The system consists of hardware to limit an input current attached at middle between single phase power supply socket and household appliances. The system integrates power electronic circuit and a PID controller in PLC to limit the value of input current based on user electrical requirement usage. The current converter behaves as feedback sensor to system with power AC controller as final control element. This can provide the elder a safe and energy saving environment and service for daily life. It is done by controlling the current input as a set point at desired value of current input from incoming ELCB 20 ampere which control using PID controller by Programmable Logic Circuit Siemens S7-1200. The signal from PLC will analysis base on control system behavior. The result that has been obtained is more significant on electrical appliances with high power consumption. Future work can be upgraded with combination of intelligent control system where the intended power requirement is automatically control using Fuzzy or Neuro Fuzzy controllers.

## ABSTRAK

Perubahan kepada kehidupan yang lebih moden membolehkan pengguna untuk menggunakan peralatan elektrik yang lebih canggih untuk memenuhi keperluan mereka. Teknologi yang melibatkan peralatan kejuruteraan elektrik telah berkembang begitu pesat bagi memenuhi permintaan pelanggan. Pengguna menghadapi kesukaran untuk mengawal penggunaan peralatan yang menggunakan tenaga elektrik yang tinggi. Projek ini membentangkan tentang sistem penjimatan kuasa dan kawalan pintar untuk penggunaan kuasa elektrik dirumah. Sistem ini terdiri daripada perkakasan untuk menghadkan arus masuk. Ianya diletakkan di antara fasa soket bekalan kuasa dan perkakas elektrik rumah. Sistem ini menggabungkan litar elektronik kuasa dan pengawal PID dalam PLC untuk menghadkan nilai semasa arus masuk berdasarkan keperluan penggunaan elektrik. Penukar arus bertindak sebagai sensor untuk memberikan maklum balas kepada sistem kuasa yang bertindak sebagai dalam pengawalan arus. Ini menyediakan persekitaran yang selamat dalam penjimatan tenaga dan perkhidmatan untuk kehidupan seharian. Ia dilakukan dengan mengawal arus masuk sebagai titik set kepada nilai yang dikehendaki oleh arus masuk daripada masuk ELCB 20Ampere yang dikawal menggunakan pengawal PID oleh PLC Siemens S7-1200. Isyarat dari PLC akan dianalisis berdasarkan tingkah laku sistem kawalan. Hasil yang diperolehi adalah lebih sesuai ke atas peralatan elektrik dengan penggunaan kuasa yang tinggi. Untuk masa depan system ini boleh dinaik taraf dengan gabungan sistem kawalan pintar di mana keperluan kuasa yang dicadangkan secara automatik mengawal menggunakan pengawal Fuzzy atau Neuro.

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**LIST OF SYMBOLS**

A	-	Ampere
P	-	Power
I	-	Current
R	-	Resistance
V	-	Voltage
KWh	-	Kilowatthour
k	-	kilo
cm	-	centimeter
$\mu$	-	micro
s	-	second

## **CHAPTER 1**

### **INTRODUCTION**

In the electrical and electronic industries, there are many methods have been developed to monitor and determine the power usage. These industries are still on development mode in determining the best and reliable testing method for producing new product quality [need reference citation].

Power savers are parts of electrical and electronic industry products and are highly in demand by market and industry. Since it is a demanding industry there is a lot method had been introduced to produce it. Technologies are trying to combine their own ways to achieve target goal to evaluate the liability of power saver to the market. Thus there is an increased need for better quality monitoring system.

For this project, smart power saver using current had been selected since it is widely used in many turfs of industries including households and heavy industries in Malaysia.

Smart power saver is not effect to our routine need since we can adjust it to our optimum need. By doing so, we can reduce extra bill required.

## **1.2 Problem Statement**

In normal circumstances, the usage of electricity with regard to power consumption at the consumer side is difficult to control. The power supplied to the household consumer rated at minimum 16Ampere primarily depends on the consumer intelligence on how effective is to economize its usage. No proper mechanism is available to solve the problem. The impact is consumer will pay higher electricity bill to the energy providing company.

By introducing the Smart Power Saver, consumer will be able plan and limit the rated value of current supply based on the expected usage at any time. Application is more focus on electrical appliances with high energy consumption such as air conditioner, washing machine, heating appliances and etc. This will enable the consumer to reduce electricity bill. Consumer can save the monthly expenses according to their planned budget on electricity bill.

## **1.3 Project Objectives**

The objectives of this project are:

- 1) To control input current from single phase supply to electrical appliances
- 2) To limit the power using PID controller – Closed loop control

- 3) To use PID controller based on PLC application

#### **1.4 Scopes of Work**

The scopes of this project are:

- 1) Design hardware for smart power saving specific for high power appliances.
- 2) Design a power electronic circuit and analysis.
- 3) Control the hardware using PID controller based on PLC.

#### **1.5 Methodology**

The approach of current limiting can be divided into several stages which are shown on the flow chart in figure 1.1 below.

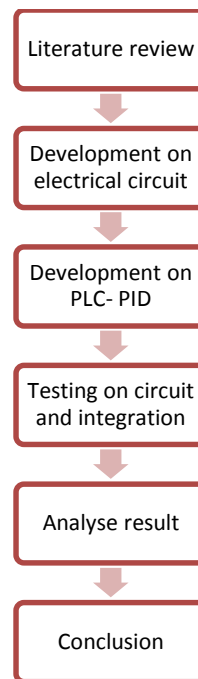


Figure 1.1: The flow chart of method to complete this project

## 1.6 Thesis Outline

Chapter 1 provides an explanation on the introduction of the project background. The explanation covers problem statement, objectives, scope of work, methodology and thesis outline.

Chapter 2 describes the background study in general and explanations based on the finding from journals, books and other sources which are used as references and guidelines.

Chapter 3 provides explanation about PID&PLC applications and tuning method. In PID, it has three mode of control which is Proportional Control, Proportional-Integral Control and Proportional-Integral-Derivative Control. For tuning, Ziegler and Nicholas method are used. Describes the method were used (current limiting) in order to complete this project.



Chapter 4 provides description of the hardware constructions and the circuits involved (Power AC Controller, PLC S7-1200, Selector Switch, AC Power Supply) producing wanted current output. Also provides explanations by comparing the results from the developed hardware regarding meet set point with under rating current. Discussion on correlation between results obtained.

Chapter5 provides explanations on conclusion of the finding obtained from the developed project and suggest or recommend other approach for future development system.

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## **APPENDIX**