“ I hereby declare that I have read through this report entitle “Development of Prototype Neural-less Time Lag Power Switch” and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power)”

Signature : .....

Supervisor’s Name : .....

Date : .....

DEVELOPMENT OF NEUTRAL-LESS TIME LAG POWER SWITCH

ATIFA FAAIDHA BINTI MUNAUWER

This Report Is Submitted In Partial Fulfillment of Requirement for the Degree Of Bachelor in Electrical Engineering (Industrial Power)

Faculty of Electrical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2012

I declare that this report entitle "*Development of Prototype Neutral-less Time Lag Power Switch*" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name : .....

Date : .....

To my beloved mother and father,
who always give me courage to finish this thesis.

Also, to those people who have guided and inspired me throughout my journey.
Thank you for the supports and advices that have been given.

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ABSTRACT

Energy technology are developing rapidly as the energy cost has continued to rise and energy issues adverse effect on different level of live in industrial or living. Hence, energy efficiency is very important to reduce the operating cost and manage the electricity efficiently. Basically, lighting contributes the highest amount of electricity usage in a building. In order to save energy efficiently, excessive use of energy in lighting system needs to be avoided since an efficient and effective use of lighting can offer major energy and cost saving. Hence, energy management for lighting system is required in order to achieve energy efficiency and save operating cost. Therefore, in this project, a prototype of Neutral-less Time Lag Power Switch is designed and developed. Neutral-less Time Lag Power Switch are the best and effective way to reduce energy consumption for lighting where it will turn off the lighting device automatically after a preset time period has elapsed. The purpose of this project is to design and develop a low cost neutral-less time lag power switch from an existing time lag switch by reverse engineering method. This device do not require a neutral connection, therefore it can be used to replace an existing light switch.

ABSTRAK

Kemajuan teknologi semakin berkembang selari dengan kos kuasa yang semakin meningkat. Malah, isu-isu yang berkaitan dengan masalah tenaga juga kian membimbangkan dan telah mendatangkan kesan terhadap pelbagai sektor masyarakat. Justeru, tenaga harus digunakan dengan cekap dan efektif untuk mengurangkan kos pengendalian tenaga. Secara asasnya, sistem pencahayaan menggunakan tenaga yang tinngi di dalam sesebuah bangunan. Jadi untuk menjimatkan tenaga, pengurusan tenaga sangat diperlukan supaya kos operasi dan kecekapan tenaga dapat dicapai. Oleh itu, dalam projek ini, suiz kuasa jarak masa tanpa neutral akan direka dan dibina. Suiz kuasa ini bertujuan untuk menutup semula lampu secara automatik setelah masa yang telah ditetapkan tamat. Suiz kuasa ini juga tidak memerlukan penyambungan neutral, maka ianya boleh menggantikan suiz lampu sedia ada.

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LIST OF ABBREVIATIONS

EE	Energy Efficiency
LCS	Lighting Control System
RC	Resistor Capacitor
SCR	Silicon Controlled Rectifier
MT1	Main Terminal 1
MT2	Main Terminal 2
AC	Alternating Current
DC	Direct Current
FKE	Fakulti Kejuruteraan Elektrik

CHAPTER 1

INTRODUCTION

1.1 Introduction to Project

The excessive use of energy in lighting system needs to be avoided since an efficient and effective use of lighting can offer major energy and cost saving. Basically, lighting contributes the highest amount of electricity usage in a building. Hence, energy management for lighting system is required in order to achieve energy efficiency and save operating cost. Therefore, in this project, a prototype of Neutral-less Time Lag Power Switch is designed and developed.

Neutral-less time lag power switch are the best and effective way to reduce energy consumption for lighting where it will turn off the lighting device automatically after a preset time period has elapsed. The device does not require neutral connection. Therefore, they can be used to replace an existing wall switch.

1.2 Project Objective

The objectives of this project are to:

i. Design and develop a prototype of Neutral-less Time Lag Power Switch for 240V lighting system.

ii. Analyzing the energy efficiency and the power consumption in FKE's Toilet by implementing the Neutral-less Time Lag Power Switch for lighting system

1.3 Project Scope

The project scope for completing this project is:

i. Design a neutral-less time lag power switch circuit by using reverse engineering method.

ii. Conduct and analyze simulation of the designed circuit by using Proteus design software.

iii. Develop a prototype of neutral-less time lag power switch

iv. Analyze the effectiveness and efficiency of the neutral-less time lag power switch in term power saving.

1.4 Problem Statement

Lighting Control System (LCS) based on switching control is needed in order to save energy efficiently and effectively. Hence, by developing a prototype of neutral-less time lag power switch, energy efficiency can be achieved by reducing unnecessary output in lighting system yet satisfy the lighting needs of the building occupant. The neutral-less time lag power switch can turn off lighting device according to time setting and reduce electrical expenditure efficiently.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Energy technology are developing rapidly as the energy cost has continued to rise and energy issues adverse effect on different level of live in industrial or living. Basically there are three ways to overcome energy issues nowadays namely energy efficiency, energy searching and energy recycling. Energy efficiency is an important item among the concept where it can reduce the energy cost while protecting the environment. [1]

Although Malaysia's energy prices are currently among the lowest in the region, a price review will follow the 74% increase in international gas prices and 17% increase in coal prices that occurred in November 2009. Speculation over Malaysian energy price rises has given companies the incentive to invest in energy saving technology, with a 20% increase in orders for energy efficiency solutions in the last quarter of 2009[2].

The use of electricity will create more carbon dioxide emission to the atmosphere [3]. Basically, carbon dioxide emission will contribute to global warming. This has aroused the awareness of the public in energy efficiency[1]. Hence, in order to protect the environment, energy efficiency becomes more vital in electrical design.

Energy efficiency means using electricity wisely in order to accomplish the same task whether at home or workplace[4]. Using energy efficiency also means paying less for electricity used to get same amount of amenities required[4]. Hence, energy efficiency is very important for reducing the operating cost and manages the electricity efficiently.

Energy efficiency is an important component of lighting design since there is great potential for saving electricity, reducing the emission of greenhouse gasses and reducing

consumer energy cost through the use of more efficient technologies and advanced lighting design and management [5].

2.2 Energy Management in Lighting System

Lighting normally contributes the highest amount of electricity usage in a building. It will consume from 20% until 50% of the electricity consumption [3]. However, there is great potential for saving electricity in term of energy consume since there are a lot of unnecessary and excessive use of energy in lighting system. Therefore, an increasing effort has gone in order to minimizing the energy consumption of lighting installation. This effort has been evolved along three major lines which are the development of new more efficient lighting equipment, the utilization of improved lighting design practices and improvement in lighting management[6].

Energy consumption for lighting system is controlled by two parameter which are power (kW) and time (h). The purpose of energy management is to allow a dynamic control over these two variables so as to satisfy the lighting need of the occupant with a minimum expenditure of energy. In order to control both variable, there are several technique can be used such as zoning, scheduling, day lighting, occupancy, luminance control, remoting, integrating and more. But the easiest way to manage energy consumption is with scheduling and day lighting control.

Scheduling technique purposes is to provide appropriate illumination level and switch lighting off when not needed. Basically, there are three hardware can be used in order to automatically scheduling the lighting system. Firstly is the personnel detector which activates the lighting circuit in response to occupancy. Next, is the mechanical time-clock that can turn the light off according to preset time setting. Lastly, a computer based programmable control system that can turn the lighting on and off according to programmable schedule.[6]

Meanwhile, day lighting control is the efficient use of skylight to satisfy lighting requirement[6]. In order to satisfy lighting requirement using this technique, a proper architectural interior design is needed to distribute the light evenly [5]. Besides the interior design of the building itself, an external hardware such as photo sensor and photo relay can be use as lighting control system in order to use energy efficiently.

Energy management using scheduling technique seems to be more efficient in term of power saving since it is easy to predict and control compared to day lighting control technique. Basically, day lighting control is hard to achieve since the illumination level of skylight are difficult to predict with certain level of accuracy.

2.3 Lighting Control System (LCS)

Lighting control system purposes is to control the use of light electronically or mechanically in order to achieve energy efficiency. Complete control of lighting system can be accomplish by several way including occupancy sensor, time-controller switch and dimming system using daylighting control.

2.3.1 Occupancy Sensing system

Occupancy Sensor method is a control method that will provide automatic lighting control to save energy efficiently. The device will turn on and off automatically according to occupancy of the building. There are two types of motion sensors that are suitable for occupancy sensor system namely infrared sensors and ultrasound sensor.

Infrared sensors use infrared radian produced by various surfaces in the space including the human body. The light is turned on when the controller that is connected to the infrared sensors receive a sustainable change on thermal signature of the environment such as occupant moves. The light will continually on until the recorded changes in temperature are not significant. Infrared sensor must be used in smaller space without partition because it only operates adequately if they are in direct line of sight with the occupant.[7]

Ultrasound sensors are a device that operates using sonar principle where it emits a high frequency sound so it is beyond the hearing range of human. The reflected sound by the surface inside a space including furniture and occupants will be sensed by a receiver. The sound wave pattern will change if people move inside the space. The light will continually on until no movement is detected for preset period of time. Ultrasound sensors may not operate properly in large spaces which tend to produce weak echoes. However, the sound wave is not easily blocked by obstacle such as wall partitions.[7]

2.3.2 Dimming System using Daylighting Control

In this system, the skylight is use to dim or turn off the light when the skylight is sufficient to satisfy the lighting requirement. To exploit daylight as the source of illumination it is necessary to establish an interactive link between ambient lighting condition and the electric lighting system[6]. Photohosensor is a device that usually uses to detect the amount of skylight in dimming system. Photosensors will detect the amount of daylight striking to it and the continuously dimmable electric lighting controller will respond to the signal produced. Illumination level will be adjusted according to the amount of daylight striking the photosensor. Through sensors and controllers, daylighting can reduce energy consumption of lighting system in a building yet satisfy the lighting need of occupant .

2.3.3 Time Controller Switch

Time controlled switch is a device that uses a mechanical clock to turn the light off automatically according to the time setting. Therefore, by using this system, the excessive or unnecessary use of lighting system could be avoided and automatically will reduce energy consumption effectively. This system is useful for scheduling technique where it occupancy pattern are reasonably well define and predictable.

2.4 Lighting Control System Requirement

Energy efficiency is an important component of lighting design, but lighting designer should also consider economics, productivity, aesthetics and consumer preferences [5]. Hence it is important for a lighting control system to meet the following requirement [8] :

i. must not disturb occupant
ii. must have a reasonable return on investment
iii. must conform to lighting standard
iv. must conform to electrical standard
v. must be reliable

2.5 Time Lag Power Switch

Time lag power switch are designed to switch light on and automatically switch off the light after the set time has elapsed. Hence, the energy consumption is also reduced effectively. Time lag power switch is suitable to use in stairwells, toilet, store room and more.

2.5.1 Operation of Time Lag Power Switch

In normal condition where the light is switches off, the red light glows inside the switch. However, the power supply to the light fitting is interrupted. Once the button has been pressed, the power will be supplied to the load for the time period set on the internal control. The red light inside the switch will turned off and the light will switched on. The power will be disconnected at the end of the time cycle. This switch uses a transistor and not a relay; this enables faster switching and prevents contact burn out to yield a longer and more reliable operating life. [9]

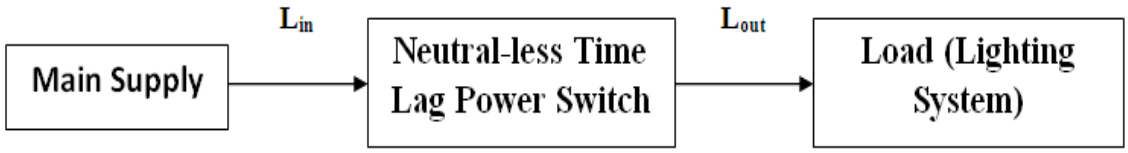

Figure 1: Lighting Control System by Using Neutral-less Time Lag Power Switch

2.5.2 Neutral-less System

Time Lag Power Switch does not require neutral connection. Therefore, they can be used to replace an existing wall switch.

2.6 Conclusion

Energy Efficiency is really important nowadays and the easiest way to achieve EE is by managing lighting energy consumption in a building where unnecessary energy is reduced. There are many ways to manage energy, and one of the easiest ways is by using LCS. In this project, a Neutral-less Time Lag Power Switch is used to turn off the light automatically after the set time is elapsed. Basically, Neutral-less Time Lag Power Switch is already in the market. However, it is very expensive and hard to find in Malaysia. So in this project, a low cost and more efficient time delay will be develop in order to reduce unnecessary energy consumption by lighting system.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter shows the flow of methodology or procedure from the beginning of project till the end of the project in order to accomplish the project. It illustrated a general picture on how the project is carried out regarding the method and the software used during the project. It is very useful if there is modification or correction is needed during completing the project.

3.2 Flow of Methodology

This project is to develop a Neutral-less Time Lag Power Switch that automatically turn off the light after the set time is elapse. After all the concepts are understood, circuit needs to be design in order to test the functionality of the system.

The flow of this project is can be divided into several stages where the first stage is literature search and review stage. During this stage, all the information about energy efficiency, energy management method and lighting control system is collected from various sources such as journal and conference paper in order to understand in detail about this project. All the information about the existing time delay switch in the market is also been collected in order to understand the in detail about the operation of the circuit. In this stage, the existing time delay switch in the market is analyzed to see its weakness and problem with it. If there any problem and weaknesses, it has to be solve and improved in this project.

Second stage is the design stage where the neutral-less time lag power switch circuit is designed by using reverse engineering method. Reverse engineering is a development method that uses information about existing product to produce a new product that has the same properties. In this project, all the information about existing time delay switch that has been collected in first stage is fully used in order to design a new circuit. In this stage, the component needed is selected based on the block diagram of the circuit. Therefore, circuit block diagram has to be indentified and analyzed first.

Third stage is the simulation stage. The designed circuit is tested by using Proteus design software. If the circuit cannot operate properly as desired, it has to be modified. But, if the circuit is running properly according to desired result, it can be analyzed in detail for further understanding on the circuit.

Next stage is the development stage. In this stage, the prototype of neutral-less time lag power switch is developed and analyzed in term of energy efficiency and power consumption.

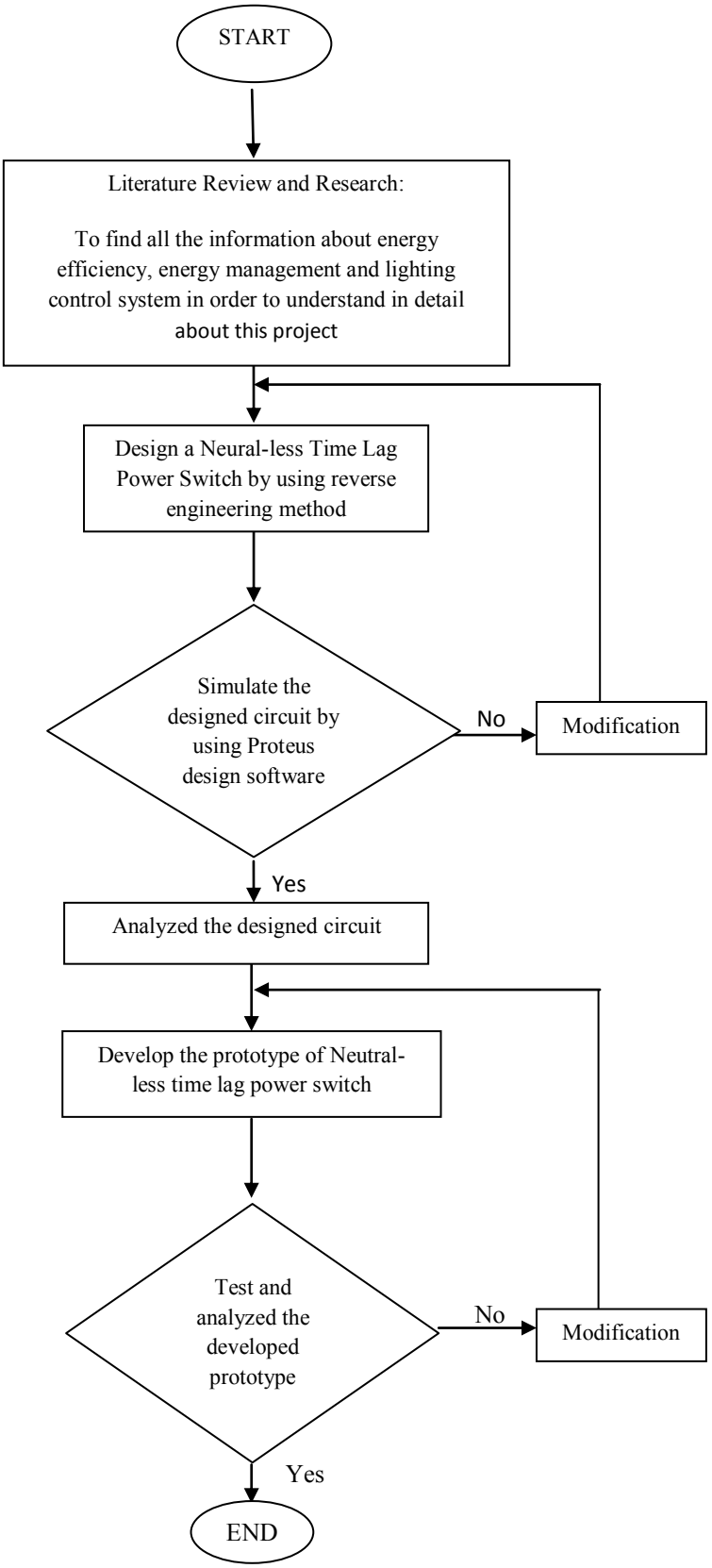

Figure 2 : Project Flowchart

3.3 Neutral-less Time Lag Power Switch Design

The circuit consists of three main circuits, which are control circuit, timer circuit and the switching circuit.

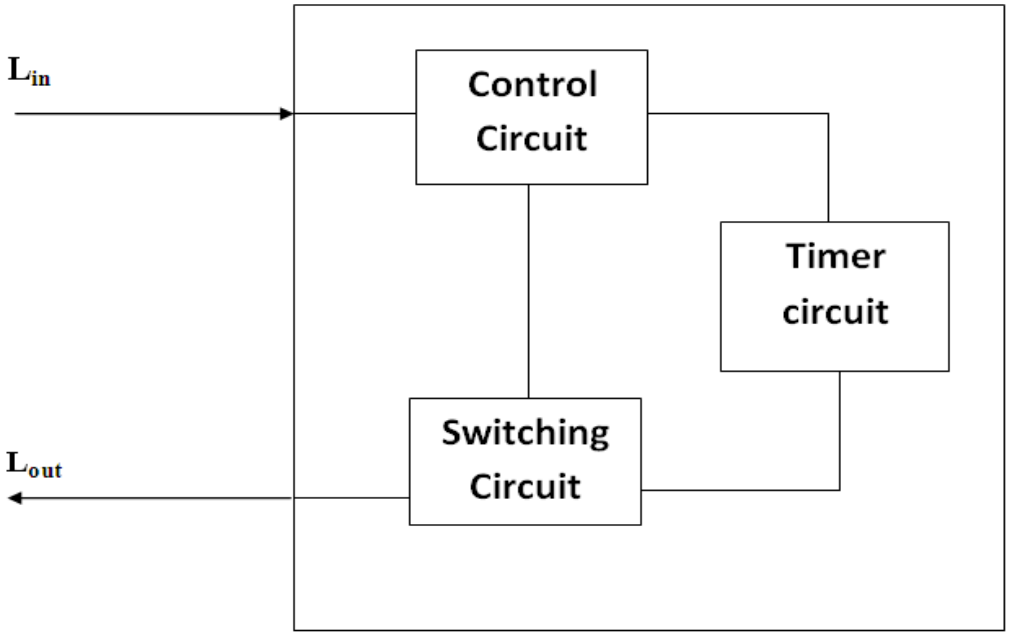

Figure 3: Neutral-less Time Lag Power Switch Block Diagram

3.3.1 Control and Timer Circuit

The purpose of control circuit is to provide disturbance to the supply so that it will not directly flow to the load. Control circuit also manipulated the time circuit in order to vary the time delay. There are several important components in this circuit such as:

3.3.2 Reverse Blocking Triode Thyristors - Silicon Controlled Rectifier (SCR)

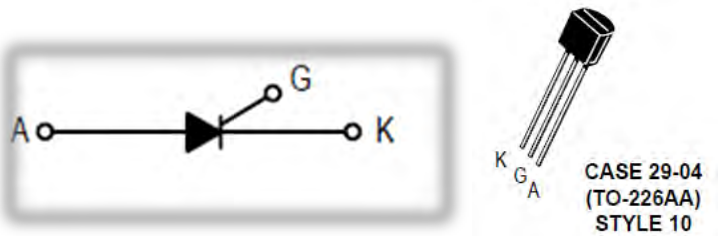

Figure 4: Thyristor Schematic Symbol