

**DEVELOPMENT OF PROTOTYPE NEUTRAL-LESS OCCUPANCY TIME LAG
SWITCH**

NOR AZREEN BIN OTHMAN

**A report submitted in partial fulfillment of the requirements for the degree
of electrical engineering (industrial power)**

**Faculty of Electrical Engineering
UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

2012

“I hereby declare that I have read through this report entitle “development of prototype neutral-less occupancy time lag 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 : Nor Azreen Bin Othman

Date : 11 JUNE 2012

I declare that this report entitle “development of prototype neutral-less occupancy time lag switch.” is the result of my own research except as cited in references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : Mr. Azhar Bin Ahmad

Date : 11 JUNE 2012

To my beloved father and mother.....

Who always give me courage to finish this project.

Also, to those people who have guided and inspired me throughout my journey.

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Abstract

In Malaysia, the use of electricity for lighting 19% of the total energy consumption, especially in commercial and public buildings . Energy can be classified into three solutions: energy conservation, energy searching and energy recycle. The concept of energy saving is one of important concept to reduce energy wastage. The efficient and effective used of lighting can reduce energy waste. In electric lighting systems, energy efficiency is dependent on control systems. Lighting sensors, timers and motion sensors is one of the electrical lighting systems. System energy efficiency should be improved and incorporated into the design of electric lighting to control energy consumption. Energy management helps to increase energy efficiency and reduce energy consumption. In addition, improvements in lighting control systems also minimize energy wastage. Development of the prototype neutral-less occupancy time lag switch is one of the projects to minimize energy wastage. This project designed to achieved energy saving concept in simple home appliances. This system is designed to detect motion through a specified area by using motion detection.

Abstrak

Di Malaysia, penggunaan cahaya elektrik adalah sekitar 19% dari jumlah penggunaan tenaga terutama di bangunan komersil atau awam [1]. Tenaga boleh diklasifikasikan kepada 3 cara penyelesaian: penjimatan tenaga, mencari tenaga dan mengitar semula tenaga. konsep penjimatan tenaga adalah salah satu konsep yang penting untuk mengurangkan pembaziran tenaga [2]. Penggunaan tenaga dengan cekap dan berkesan dapat mengurangkan pembaziran tenaga. Dalam sistem pencahayaan elektrik, kecekapan tenaga adalah bergantung kepada sistem kawalan. Alat pengesan pencahayaan, pemasa dan alat pengesan gerakan adalah salah satu sistem kawalan lampu elektrik. Sistem kecekapan tenaga perlu diperbaharui dan dimasukkan ke dalam reka bentuk pencahayaan elektrik untuk mengawal penggunaan tenaga. Pengurusan tenaga dengan baik membantu untuk meningkatkan kecekapan tenaga dan mengurangkan penggunaan tenaga. selain itu, penambahbaikan dalam sistem kawalan pencahayaan juga meminimumkan pembaziran tenaga[3]. Contoh kawalan pencahayaan adalah termasuk mereka bentuk sistem pencahayaan yang lebih baik dan peningkatan sistem kawalan pencahayaan. sistem prototaip suis tanpa neutral dengan alat pengesan gerakan untuk melambatkan masa telah direka untuk meminimumkan pembaziran tenaga elektrik. sistem ini direka untuk mencapai konsep penjimatan tenaga elektrik dalam peralatan rumah.

TABLE OF CONTENT

CHAPTER	TITLE	PAGE
	Acknowledgement	iv
	Abstrak	v
	Abstract	vii
	List of tables	xi
	List of figures	xii
	List of symbols	xiii
	List of abbreviations	xiv
1	Introduction	1
	1.1 Overview	1
	1.2 Project Objective	1
	1.3 Project Scope	2
	1.4 Problem statement	2
2	Literature Review	3
	2.1 Introduction	3
	2.2 Case problem	4
	2.3 Energy Efficiency	4
	2.3.1 Control System	4
	2.3.2 Energy Management	5

2.3.3	Lighting Design	5
2.4	Sensor	6
2.4.1	Type Of Sensor	6
2.4.1.1	Motion Detecting Sensor	6
2.4.1.1.1	Ultrasonic Or Ultra Sound (US)	7
2.4.1.1.1.1	Measurement Principle Of Ultrasonic Sensor	7
2.4.1.1.1.2	Ultrasonic Sound Specification	8
2.4.1.1.1.3	Advantage Of Ultrasonic Sensor	8
2.4.1.1.1.4	Disadvantage Of Ultrasonic Sensor	8
2.4.1.1.2	Microwave Sensor	9
2.4.1.1.2.1	Microwave sensor Specification	9
2.4.1.1.2.2	These devices can be found in the following classes.	10
2.4.1.1.2.3	The advantage of microwave sensor	10
2.4.1.1.2.4	The disadvantage of microwave sensor	10
2.4.1.2	Heat-Detecting Sensor Or Infrared Sensor	11
2.4.1.2.1	Infrared Or Passive Infrared Sensor (PIR)	11
2.4.1.2.2	PIR Sensor Specifications:	12
2.4.1.2.3	PIR sensor sensitiviti	12
2.4.1.3	Sound Sensing Sensor	13
2.5	Timer Circuit	13
2.5.1	RC Circuit	13
2.5.2	555 Timers	14
2.5.3	Counter	15
2.5.4	Flip-flop	15
2.6	Control Circuit	15
2.6.1	Power electronic Circuit	15
2.6.1.1	Power semiconductor Device	16
2.6.1.2	Power Diode	16

	2.6.1.2.1	Type Of Power Diode	17
	2.6.1.3	Thyristors	18
	2.6.1.3.1	SCR Thyristor	18
	2.6.1.3.2	Triac Thyristor	19
	2.6.1.4	Transistor	19
	2.7	Power Supplies	20
	2.7.1	Neutral-Less Supply	21
3		Methodology	22
	3.1	Introduction	22
	3.2	Literature Review And Research	23
	3.3	Circuit design	23
	3.3.1	Project Block Diagram	24
	3.3.2	Passive Infrared Sensor (PIR)	25
	3.3.3	Flip-Flop	26
	3.3.4	Control Circuit selected	27
	3.3.4.1	Power Electronic	27
	3.3.5	Timer Circuit	28
	3.3.5.1	RC Circuit	28
	3.4	Power Supplies	28
	3.4.1	Control circuit power supplies.	28
	3.4.2	PIR motion sensor power supplies	29
	3.5	Simulate the circuit design	29
	3.6	Design the circuit layout by using ORCAD	29
	3.7	PCB etching process	30
	3.8	Final process	31
	3.9	Project cover	32
4		Result and discussion	33
	4.1	Result	33

	4.2	Result and discussion the simulation circuit.	34
	4.3	Time delay on simulation circuit.	38
	4.4	Hardware circuit.	39
	4.4.1	Control circuit result and discussion.	39
	4.4.2	PIR Sensor result and discussion.	40
	4.4.3	Hardware result (time delay)	41
	4.4.4	Time delay calculation	42
	4.4.5	FKE corridor electricity bil.	43
	4.5	FKE corridor electricity bill for standard lighting switch system.	44
	4.5.1	Total electricity bill	47
	4.5.2	FKE corridor electricity bill	52
	4.5.3	Total electricity bill	55
	4.6	Electricity bill saving	59
5		Analysis and discussion	60
	5.1	Introduction	60
	5.2	Simulation circuit.	60
	5.3	Hardware circuit	61
	5.4	PIR sensor circuit	62
	5.4	Control circuit time delay.	63
	5.5	Energy efficiency	64
6		Conclusion and recommendation.	65
		Reference	66

LIST OF TABLE

Table	Title	Page
2.1	Ultrasonic Sound Specification	8
2.2:	Microwave sensor specification	9
2.3:	PIR sensor specification	12
3.1 :	PIR sensor	25
3.2;	Flip-flop Output Voltage (3)	26
3.3:	Flip-flop output voltage (11)	26
3.4 :	Thyristor specification	27
4.1:	The voltage at 240V AC circuit (off mode)	34
4.2:	The voltage at 240V AC circuit (on mode)	35
4.3	The voltage measured (off mode) at control circuit	36
4.4	The voltage measured (on mode) at control circuit	37
4.5	Time delay on the control circuit	38
4.6	Result from control circuit.	39
4.7	Result from PIR sensor circuit	40
4.8	Time delay on the control circuit.	41
4.9	Total electricity bill.	43
5.0.	The observation at FKE corridor.	43
5.1	The observation result in the Block A of FKE corridor using standard switch system	45
5.2	The observation result in the Block B of FKE corridor using standard switch system	46
5.3	The observation result in the Block A of FKE corridor when implement the Neutral-Less Occupancy Time lag Switch	53
5.4	The observation result in the Block B of FKE corridor when implement the Neutral-Less Occupancy Time lag Switch.	54

5.5	The total electricity bil	59
5.6	Time delay result	63

LIST OF FIGURES

FIGURE	TITLE	PAGE
2.1:	Ultrasonic sensor	7
2.2:	Ultrasonic transmit	7
2.3:	Microwave sensor	9
2.4:	Passive infrared sensor (PIR)	11
2.5:	Mini sound sensor	13
2.6:	Power semiconductor device	16
2.7:	Power diode	17
2.8:	SCR Thyristor	18
2.9:	Triac thyristor	19
3.10	Project flow diagram	22
3.2:	System block diagram	24
3.3	Sensor circuit	25
3.1	Circuit Layout using ORCAD software	29
3.5:	Step one for etching process	30
3.6:	Step two for etching process	30
3.7:	Step three for etching process.	31
3.8:	Circuit front view.	31
3.9:	Back view	32
4.0:	Front view	32

LIST OF SYMBOLS

mA	Milliampere
DC	Direct current
AC	Alternating current
V	Volt
m	Meter
° C	Degree
τ	Tau
R	Resistor
C	Capacitor
Q	Charge of capacitor
K Ω	Kilo ohm

LIST OF ABBREVIATIONS

FKE	Faculty Of Electrical Engineering
UTeM	Universiti Teknikal Malaysia Melaka
IEEE	Institute Of Electrical And Electronic Engineers
US	Ultrasonic Sounds
PIR	Passive Infrared sensor

CHAPTER 1

Introduction

1.1 Overview

Electricity is the one of important energy in our life. The use of electricity increase everyday because we do not have the awareness about the electricity and the importance to our daily life. Energy can be classified into 3 solutions: energy saving, energy searching and energy recycles[1]. The efficient and effective used of lighting can reduce energy waste[2]. Thus, the energy saving project will be created based on the lighting switch system. Sometimes, we forget to switch off the light in our home. Based on this problem, the neutral-less occupancy time lag switch system is developing to control the lighting system in our home. This project is designed to achieve energy saving concept in simple home appliances. This system is designed to detect motion through a specified area by using motion detection sensor.

1.2 Project Objective

The general objective of the system is to reduce electrical energy wasted. We can see that a lot of energy wasted happened every day. The better energy saving system must be made to prevent this problem. The objectives of this project are:

- i) To design and development of prototype Neutral-Less Occupancy Time Lag Switch.
- ii) To design and built the energy saving system that can reduce energy waste.

- iii) To design low cost prototype motion detector switch.
- iv) To design the lighting control system based on switch system.

1.3 Project Scope

- i. Design and develop a prototype of neutral-less occupancy time lag switch for 240V AC lighting system.
- ii. Analyze the neutral-less occupancy time lag switch in term of energy efficiency and power consumption at Faculty of Electrical Engineering (FKE) corridor.

1.4 Problem statement

This project designed to achieve energy saving concept in simple home appliances. As we know, the switch that has used today not using lighting control system. The switch not turns off automatically although the room stays unoccupied for a preset amount of time. To solve this problem, this project develops by using motion detection system to control lighting system and reduce energy waste. For this project, the systems used are neutral-less system based on the switch that also using neutral-less system. So, this project develops for neutral-less system. This project also develops for low cost detector switch prototype.

CHAPTER 2

Literature Review

Literature review is important in each project as a base for gathering information necessary to complete the project. All information is gathered from various sources such as:-

- i) Journal
- ii) Books
- iii) Reverse engineering
- iv) Thesis
- v) Website

2.1 Introduction

Literature review is the full fill to understand the overall concept for develop occupancy time lag switch. Furthermore, to accomplish the literature review, reference from several sources such as books, online searching, IEEE journals is required for analysis, collecting information, and referring to research which related to this project.

2.2 Case problem

This energy control system is design to achieve energy saving concept in simple home appliances. With this control system, the use of electricity will be reduced. As we know, the switch that has used today not using lighting control system. The switch not turns off automatically although the room stays unoccupied for a preset amount of time. To solve this problem, this project develops by using motion detection system to control lighting system and reduce energy waste. As we know, all sensor control system using neutral. For this project, the systems used are neutral-less based on the switch that also using neutral-less system. So, this project develops for neutral-less system. This project also develops for low cost detector switch prototype.

2.3 Energy Efficiency

Energy efficiency is means for using electricity wisely. Energy efficiency is important to minimize the energy waste. It's important to include the energy efficiency system in the lighting system. The efficient use of system can reduce energy waste. There are many ways to used energy efficiency:

- i) Control system
- ii) Energy management
- iii) Lighting design system

2.3.1 Control System

Control system is one of energy efficiency system that used to reduce energy waste for example in lighting system[3]. The automatic control of power system is one of the system that save electrical energy that used controlling mechanisms managed by a microcontroller[3].

The system that used this system include system control relative to the room temperature, light control relative to the natural light intensity in the room and motion detection system to detect motion through a specified area by using motion detection[3].

2.3.2 Energy Management

Energy efficiency depends also on the energy management. Energy management is applied to industrial to efficient the electrical consumption and also to minimize the energetic cost[4]. The system that used in this system include development of energy consumption monitor system, specific strategies of optimization and attractable the proposals for the employs the efficiency energy consumption programs[4].

2.3.3 Lighting Design

Lighting designs also one of energy efficiency system. The lighting includes the lighting coordinated selection, fixtures placement and room finishes[5]. There are many factors that affect the lighting performance especially at room such as paint colors, reflection factor, maintenance factor and utilization factor[2]. Lighting condition is important to giving perfect illumination. By reduce the luminance level, through decrease the feeding voltage of the lamp, so the electrical consumption can be decrease. Electronic ballast is one of the lighting systems that widely used in the world. The efficiency of electronic ballast is 20-30 percent more than magnetic ballast. Electronic ballast one of the lighting systems that used efficiency concept.

2.4 Sensor

Sensor is a device that measures a physical quantity and converts it into a signal. Sensor changes one energy form into another form. Sensor can be classified according to the type of energy transfer. A good sensor should be more sensitive to the measured property and should not influence to the measured property.

There basic functions of sensor

- i) Turn on light automatically when detect the motion
- ii) Keep the light always turned on without interruption while the controlled space is occupied
- iii) Turn off the light within a present time period after the space has been vacated

2.4.1 Type Of Sensor

Generally, there are three categories of occupancy sensor. The types of sensor are:

- 1) Motion detecting sensor
- 2) Heat-detecting sensor or infrared sensor
- 3) Sound sensing sensor

2.4.1.1 Motion Detecting Sensor

There are two categories of motion sensor, there are:

- i. Ultrasonic or ultra sound (US)
- ii. Microwave sensor

2.4.1.1.1 Ultrasonic Or Ultra Sound (US)



Figure 2.11: Ultrasonic sensor

Ultrasonic is a sensor that generate high frequency sound wave. Ultrasonic sensor contains ultrasound generator and receiver. Ultrasonic sensor changes the wave detected and sent the positive signal to the controller. The advantage used this sensor is it more sensitive to the motion and can detect the motion that is not in their line-of sight. However, this sensor is more expensive compared to the PIR sensor.

2.4.1.1.1.1 Measurement Principle Of Ultrasonic Sensor

Ultrasonic sensors transmit ultrasonic wave and receive the ultrasonic wave reflected from the object. The ultrasonic sensor detects the position of the object by measuring the length of time from the transmission to reception.

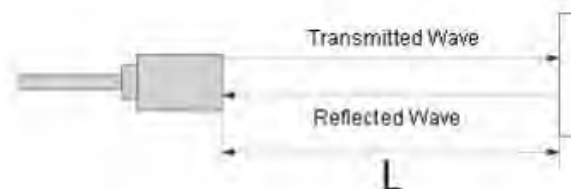


Figure 12.2: Ultrasonic transmit

2.4.1.1.1.2 Ultrasonic Sound Specification

Table 2.4 Ultrasonic Sound Specification

Power supplies	5V DC
Current	<2mA
Effectual angle	<15°
ranging distance	2cm – 500 cm

2.4.1.1.1.3 Advantage Of Ultrasonic Sensor

- i) Discrete distances to moving objects can be detected and measured.
- ii) Less affected by target materials and surfaces
- iii) Not affected by color.
- iv) Small objects can be detected over longer distance

2.4.1.1.1.4 Disadvantage Of Ultrasonic Sensor

- i) Not function well in rooms with wall to wall carpeting and drapery
- ii) It is impossible to discern between reflected waves from other place or objects