DESIGN OF SOLAR-POWERED GARDEN LIGHT WITH MOTION SENSOR

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SUPERVISOR DECLARATION

"I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Design & Innovation)"

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DECLARATION

" I hereby declare that the work in this thesis is my own except for summaries and quotations which have been duly acknowledge."

Signature:................................

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Date:...

For my beloved family

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ABSTRACT

Nowadays, many lighting application require complicated wiring such as home lighting appliances. From main power to the specific lighting equipment, the amount of wire for installation is large and messy. In order to solve the wiring problem, solar powered garden light is introduced. This study cover on step by step in order to design a solar powered garden light with motion sensor. Motion sensor is included in the solar garden light as it function available in market is monotonous. The calculation about specification, selection of components, assembly and performance assessment of solar garden light included in this thesis. The design process began with the amount of light lumen require in order to illuminate a predetermined area of a garden. The next step covered on the wattage and the types of lighting element and sensor that fit the criteria. Choosing the right battery and solar panel were the next steps. Schematic circuit design is done after choosing of components. The physical body of solar garden light is designed as well as the materials selection. Final step focus on the performance assessment of solar garden light. Parameter such as sensing distance and field of vision of the sensor, luminance of the LED and operating hours of solar garden light are tested. A prototype of circuit of motion sensor solar garden light was done at the end of the project with sensing distance of 4 *meter* , 30º dispersion angle, 100 *lumen* brightness, and minimum of six hours of operating hours. Physical body is designed with the suitable materials but the fabrication of physical body is not included in this study.

ABSTRAK

Pada masa kini, banyak kegunaan lampu memerlukan pendawaian yang rumit contohnya peralatan lampu di rumah. Dari bekalan elektrik utama untuk peralatan pencahayaan tertentu, jumlah wayar untuk pemasangan atau pendawaian wayar adalah banyak dan tidak kemas. Dalam usaha untuk menyelesaikan masalah pendawaian, lampu taman solar diperkenalkan. Ini akan merangkumi pada langkah demi langkah untuk merangka lampu taman yang menggunakan kuasa solar bersama dengan sensor gerakan solar. Sensor gerakan termasuk dalam lampu taman solar kerana lampu kini yang terdapat di pasaran adalah tidak menarik. Pengiraan mengenai spesifikasi, pemilihan komponen, pemasangan dan analisis lampu taman solar dibincang dalam tesis ini. Proses reka bentuk bermula dengan jumlah percahayaan yang memerlukan untuk menerangi kawasan di taman. Langkah seterusnya meliputi watt dan jenis elemen pencahayaan dan sensor yang sesuai dengan kriteria tersebut. Langkah seterusnya adalah pemilihan bateri dan solar panel. Reka bentuk litar skematik selepas pemilihan komponen. Rangka fizikal lampu taman solar juga direka serta pemilihan bahan untuk rangka tersebut. Langkah terakhir memberi tumpuan kepada analisis lampu taman solar. Parameter seperti jarak dan sensitiviti sensor, keterangan LED, masa operasi lampu taman solar diuji. Satu prototaip litar sensor lampu taman solar difabrikasikan pada akhir projeck dengan mempunyai fungsi seperti jarak penderiaan sensor empat meter, 30^{o} sudut serakan, 100 lumen kecerahan, dan jam waktu operasi sekurang-kurangnya enam jam. Badan fizikal direkan dengan bahan yang sesuai tetapi fabrikasi badan fizikal tersebut tidak termasuk dalam projek ini.

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LIST OF SYMBOLS

I_{ph}	=	Photocurrent source
D	=	Diode
R_s	=	Series Resistance
I	=	Net Current
I_D	=	Diode Current
m	=	Idealizing factor
k	=	Boltzmann's gas constant (1.38 x 10^{-23} J/K)
T_c	=	Absolute Temperature of Solar Cell
e	=	Electronic Charge (1.6 x 10^{-19} C)
V	=	Voltage Imposed Across Cell
I_0	=	Dark Saturation Current (depending on temperature)
G_a	=	Solar Irradiation
P_{max}	=	Maximum Power
V_{max}	=	Maximum Voltage
I_{max}	=	Maximum Current
W	=	Watt
m^2	=	Meter Surface Area
φ	=	Latitude

δ	=	Solar Declination
Hz	=	Hertz
lm	=	Lumen
cd/mcd	=	Candela/ Milli Candela
sr	=	Steradians
Φ	=	Luminous Flux
I_v	=	Luminous Intensity
Ω	=	Solid angle
θ	=	Apex Angle
E	=	Voltage Source
i / I_{char}	=	Charging Current
r	=	Internal Resistance
E_0	=	Battery to Charge
P	=	Power Stored
E_{cons}	=	Energy Consumed
I_{bat}	=	Battery Ampere
V_{bat}	=	Battery Voltage
V_{solar}	=	Solar Panel Voltage
P_{solar}	=	Solar Panel Power
$P_{charging}$	=	Solar panel Charging Power

LIST OF ABBREVIATION

PV	=	Photovoltaic
LED	=	Light Emitting Diode
IEE	=	Institute of Electrical & Electronic Engineers
TNB	=	Tenaga National Berhad
HPS	=	High Pressure Sodium
DC	=	Direct Current
AC	=	Alternative Current
FC	=	Foot Candle
psh	=	Peak Sun Hour
SMD	=	Surface Mount Device
SI	=	System International
IESNA	=	Illuminating Engineering Society of North America
UV	=	Ultraviolet
NIR/IR	=	Infrared
emf	=	electromotive force
PCB	=	Printed Circuit Board
Isc	=	Short Circuit Current
Voc	=	Open Circuit Voltage
FF	=	Fill Factor
Li	=	Lithium
MPP	=	Maximum Power Point

NLPIP	=	National Lighting Product Information Program
SHS	=	Solar Home System

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CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

Photovoltaic or PV is currently one of the most attractive options for renewable energy resources around the world (PV Industry, 2009). PV system application can be divided into 2 distinctive categories, which are grid-connected system and stand alone (off -grid system). In Grid-connected PV systems, energy storage is not required as solar radiation provides power and if there is surplus energy, it can be transferred into grid and operates by linking the solar PV with the utility-grid connection (Djamila et al, 2012). In standalone PV systems, electrical power is necessary from the system during night or dusk. Thus the storage must be added to system. Generally, rechargeable battery is used for energy storage (Djamila et al, 2012). Both system are widely applied in Malaysia, The standalone system will be further discussed in this section.

One of the application of standalone photovoltaic system is lighting system. The use of standalone photovoltaic lighting system has increased ubiquitous as it need little maintenance. silent, and free of moving parts. PV lighting system are self contained; there are no trenches, no external cabling, and no need to connect to the main power grid. PV lighting systems are apply to various fields including garden to parking lot and also street lighting.

In term of number of installations, lighting is presently the biggest application of photovoltaic, with tens of thousands of units installed worldwide (Markvart, 2010). They are mainly used to provide lighting for domestic or community building, such as schools or health centre. PV is also being increasingly used for lighting streets and tunnels, security lighting, and garden lighting.

Solar garden light is a cheap alternative to Solar Home System (SHS) which can provide 7 - 8 hours of lighting. It brighter than candle and kerosene lamp. Besides, it is wireless and contain no moving parts and make it easy to be install at everywhere in a garden. It is used as an alternative in enhancing any garden especially when the site not connected to utility grid. On the other hand, it requires minimal maintenance and reliable. It can be an awesome decorative item in garden too. In this project, the aim is to design a prototype of a standalone PV system for garden lighting application.