Faculty of Electrical and Electronic Engineering Technology

MODIFICATION OF SOLAR ENERGY MANAGEMENT FOR LIGHTNING DETECTION SYSTEM BY OPTIMIZING THE OPERATION OF THE CONTROLLER SYSTEM

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Bachelor of Electronics Engineering Technology with Honours

2022

MODIFICATION OF SOLAR ENERGY MANAGEMENT FOR LIGHTNING DETECTION SYSTEM BY OPTIMIZING THE OPERATION OF THE CONTROLLER SYSTEM

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A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology with Honours

Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2022

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : MODIFICATION OF SOLAR ENERGY MANAGEMNET FOR LIGHTNING DETECTION SYSTEM BY OPTIMIZING THE OPERATION OF THE CONTROLLER SYSTEM

Sesi Pengajian : SESI 1 2021/2022

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I declare that this project report entitled "MODIFICATION OF SOLAR ENERGY MANAGEMENT FOR LIGHTNING DETECTION SYSTEM BY OPTIMIZING THE OPERATION OF THE CONTROLLER SYSTEM" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree MODIFICATION OF SOLAR ENERGY MANAGEMENT FOR LIGHTNING DETECTION SYSTEM BY OPTIMIZING THE OPERATION OF THE CONTROLLER SYSTEM

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Date : 31/1/2022

Signature :

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Name (if any)

Date :

DEDICATION

To my beloved mother, Nor Hasmah binti Puteh, and father, Yakup bin Ali,

and

To dearest siblings,

Shazwan, Shazliza Azzyya, Hariz, Haraz,

who have been my source of inspiration and continually giving me

moral, spiritual, and emotional support.

ABSTRACT

Malaysia is one of the nations that situated in the tropical reach. It is also a country with heat and humidity consistently and furthermore rich in daylight. Nowadays, with the steadily extending technologies, natural resources have formed the industry's base and are used as a supply generation in nowadays usage. Solar energy is most reliable renewable sources of energy that most of the people use nowadays. Solar energy can be harvested from the light energy into electrical energy by using solar power system. A solar charge controller which also known as a solar regulator is one of the most important components of a solar system. The function of a solar charge controller is to adjusts the current as well as the voltage from the solar panels to the batteries or load, preventing the battery from being damaged by an overcharge condition.

In this project, the energy of 200W produced by mono crystalline the solar panels will be connected to the solar charge controller through a 12V PWM system. From the solar charge controller, the energy will be regulated to 12V to be delivered to the 12V 10Ah battery and to the load of 70W which consist of the cooling system and the lightning detection system. However, it appears the load only consume the power supply coming from the battery and it unable to consume the power supply directly from the solar system. The goal of this project is to make it possible for the generated energy to be used from the solar system directly to the load without any help from the battery. By enhancing the solar charge controller's performance in a solar power system, the Lightning Detection system project tend to be able to operate directly by energy provided by the solar power system in a certain situation and operate using the energy stored in the battery storage for a certain situation hence improve the performance and efficiency of the Lightning Detection System.

ABSTRAK

Malaysia merupakan negara yang terduduk di kawasan tropika. Ia juga merupakan sebuah negara yang mempunyai haba dan kelembapan yang berterusan dan begitu juga dengan cahaya matahari. Tenaga solar merupakan tenaga diperbaharui yang kukuh yang Berjaya menambat perhatian orang ramai di zaman ini. Tenaga solar dapat dimiliki dengan mengubah tenaga cahaya matahari kepada tenaga eletrik melalui sistem kuasa solar. Sebuah alat pengawal caj solar yang juga dikenali sebagai solar regulator adalah salah satu bahagian penting dalam sistem kuasa solar. Fungsi alat tersebut adalah untuk mengatur arus dan voltan yang datang daripada papan solar disalurkan kepada bateri atau kepada beban dan mengelak bateri daripada rosak akibat caj yang berlebihan.

Projek ini menggunakan 200W papan solar monocrystalline yang menghasilkan kuasa sebanyak 200W yang disalurkan ke 12V PWM pengatur caj solar. Tenaga tersebut kemudian akan diregulasikan kepada 12V dan disalurkan ke 12V 100Ah bateri dan kepada 70W bebanan yang merangkumi sistem penyejukan dan sistem pengesan petir. Namun begitu, sistem ini hanya beroperasi menggunakan sumber tenaga dari bateri dan ia tidak mampu untuk beroperasi menggunakan sumber tenaga terus dari sistem kuasa solar. Tujuan bagi projek ini adalah untuk membolehkan tenaga yang dijana daripada sistem kuasa solar disalurkan terus kepada beban tanpa perlu melalui bateri. Dengan mengoptimumkan operasi pengatur caj solar dalam sistem kuasa solar, projek Sistem Pengesan Petir dijangka mampu untuk beroperasi secara terus menggunakan tenaga daripada sistem kuasa solar dalam keadaan yang tertentu dan kembali beroperasi menggunakan tenaga dari bateri dalam keadaan tertentu sekaligus meningkatkan perestasi dan kecekapan Sistem Pengesan Petir.

ACKNOWLEDGEMENTS

First and foremost, all the praises to The Almighty and The Most Merciful, Allah SWT for the blessing on my research work to complete this project.

I would like to express my deepest gratitude and appreciation to Universiti Teknikal Malaysia Melaka (UTeM) and my supervisor, Ts. Dr. Zikri Abadai bin Baharudin for giving the oppurtunity to do this project and providing me all the support throughout completing this project. I am very fortunate as the success and final outcome of this project required a lot of assistance and guidance from him.

I would like to express my humbleness and gratefulness to all those who have helped me during the completion of this project, especially my family who have been supportive either morally, financially and physically.

Last but not least, my biggest thank you to all of my classmates and friends. If not because of their generous support and always having my back through this journey, I will not be able to be at this point of my life

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CHAPTER 1

INTRODUCTION

1.1 Background

A solar charge controller which also known as a solar regulator is among the most important components of the solar power system. Its connected in between three part of the system which consist of solar panel, battery, and load. The function of a solar charge controller is to controls the current and voltage from the solar panels to the battery or load. It also able to ensure the battery is charged in the right a strategy to keep the battery from being harmed by overcharging the battery. PWM solar charge controllers and MPPT solar charge controllers are the two types of solar charge controllers. The PWM solar charge controller works by gradually reducing the amount of power given to the battery as it approaches its capacity limit, and it can only work when the solar panel system voltage is equal to the battery voltage. The MPPT solar charge controller can operate even if the voltage from the solar system and the battery is not matching because it can adjust the incoming power from the solar system delivered to the battery to prevent it from overcharging.

In this Lightning Detection System, the energy of 200W the solar panels' output will be routed to a 12V PWM solar charge controller. From solar charge controller, The flow of energy will be adjusted to 12V to be delivered to the 12V 10Ah battery and to the load of 70W which consist of the cooling system and the system for detecting lightning. The goal of this project is to connect the solar system's generated electricity directly to the load without the use of a battery for a certain situation and for the charge controller to deliver the power form the battery to the load whenever solar system unable to generate sufficient power.

1.2 Problem Statement

Based on the final year report performed by Hairi (2019), it reported that the solar panel featuring 12V and 200W was manageable with total of load of 70W within 24hr or continuous operation using a 12 PWM solar charge controller. However, this project was found to have a weakness. It appears the load only consume the power supply coming from the battery and it unable to consume the power supply directly from the solar system. These circumstances drain the battery during the daylight and the battery continuously being used making its unable to sustain the supply power for the lightning detection system for it to operate for the whole night. This problematic issue motivated me to introduce the solution by modifying the controller of the solar power system.

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1.3 Project Objective

- To select suitable controller which able to optimize the incoming energy from the solar panel and supply it to the load
- To find a suitable battery which able to store and supply enough energy to the load in all condition
- To analyse the performance of the controller operation during daylight and night.

1.4 Scope of Project

This project focuses on solar energy generation, which generates 12V from two 200 W solar panels. The energy produced by the solar system flow to the 12V PWM solar charge controller to be delivered and charge the 12V 10Ah/20Hr battery storage and a 50W power supply for the cooling box system, as well as sensor for a system that detect lightning (20W). The scope will be determined by the total load to be supplied, battery storage, cooling system requirements and the lightning detection system. This project focusing on the operation of solar power system and solar charge controller and analyze the reliability of the operation of the solar charge controller during daylight and nighttime.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter will expounds about the project that related with this topic which has been made by another researcher. A few past project are used as a reference to complete this new development. Furthermore, information in this chapter also explain about the main component that will uses for develop the Lightning Detection System project.

2.2 Solar Power System

For the planet Earth, the sun well known a significant source of endless energy. At present, more technology is utilized for creating power based on reaped solar power. These methodologies effectively been demonstrated and broadly rehearsed all through the world as sustainable options to customary non-hydro powered technologies [1]. Figure 2.2.1 shows an examination of non-hydro renewable energy among nations for the year 2012. Hypothetically, solar power has possibility to sufficiently satisfy the energy requests coming from the entire world when innovations for collecting as well as providing are promptly accessible. Almost 4,000,000 exajoules of solar energy arrives at the earth every year, is said to be capable of being harvested. Regardless of its huge possibility and development in consciousness, solar power contribution to the global power supply is currently negligible [1].

Solar energy has the most significant global potential since geothermal sources of energy are confined to a few regions, as well as the inventory of biomass cannot be found

everywhere in the nature. Many factors like diurnal variety, scope, environment, as well as the geographical diversity are to a huge extent liable for determining the power of the solar influx that is passing through the Earth climate. The common measurement of solar power got at the climate is about 342 W m−2. From this amount of power, 30% of it is absorbed or sent back to the space, while the remaining 70% which is about 239 W m−2 can be obtain and harvest. The yearly effectiveness of the solar irradiance changes from 60 W m−2 to 250 W m−2 around the world. Figure 2.2.2 portrays the yearly normal power of the solar irradiation over the outside earth. Exploration shows that "dark spot" regions able to give higher energy than the whole world all out essential power interest when a transformation productivity of less than 8% is achieved [1].

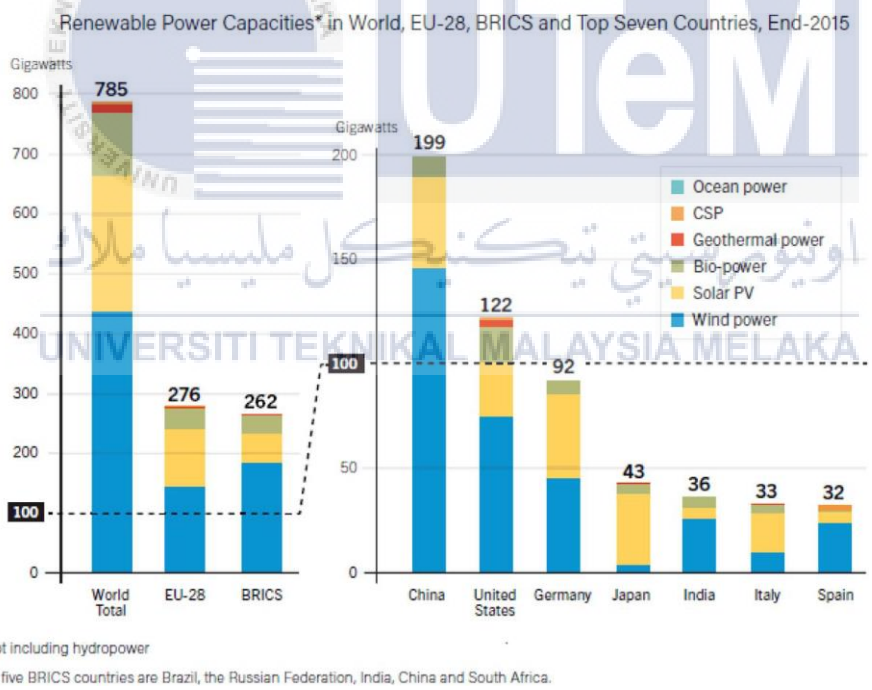

Figure 2.2.1: non-hydro renewable source of energy capacity comparison between nations

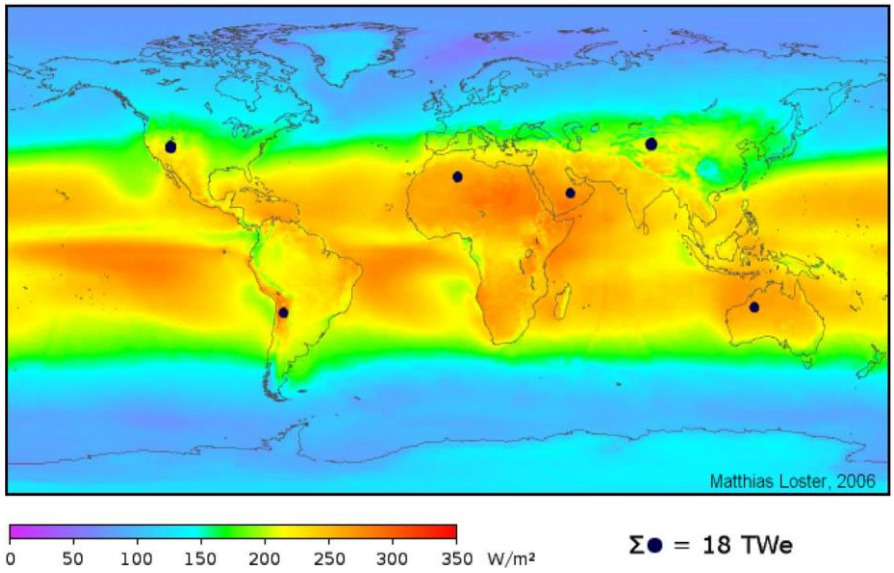

Figure 2.2.2: The annual average amount of solar energy irradiance that reaches the Earth's surface.

2.3 Main Part of Solar Power System

There is various part that are needed to build a solar system such as solar panel, batteries, and solar charge controller. These are the basic component to build a solar system but there always more device that can be place in the solar system to make the solar system produce the desired output.

2.3.1 Solar Panels

A solar panel, also known as a photovoltaic (PV) module, is an installation of photovoltaic cells arranged in a framework. Solar panels generate direct current electricity using sunlight as a source of energy. A PV panel is a collection of PV modules, while an array is a group of panels.

Every year practically 5×1024 J of energy is given by the sun and hits the outside of the earth [2]. This amount is multiple times higher than the real yearly energy utilization of the entire world. Among different renewable energy assets accessible, solar energy has as of late been developed as the main pursued wellspring of sustainable power because of the year-around wealth of daylight and furthermore because of the innovative advances in catching the light energy. Throughout the long term, solar PV power cells have figured out how to be the fundamental wellspring of tackling solar power since they are inexhaustible as well as protected and liberated from contamination [2]. The PV arrays all alone give a moderately monetary strategy for creating power with high effectiveness.