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**MODELING AND CONTROL STAND-ALONE PV SYSTEMS USING VOLTAGE
MODE CONTROL DC CONVERTER METHOD**

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**A report submitted in partial fulfillment of the requirements for the degree of Electrical
Engineering (Power Electronic and Drives)**

Faculty of Electrical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2012

I declare that this report entitle “*Modeling and Control Stand- Alone PV system using voltage mode control DC converter method*” 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.

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In the name of ALLAH, The Most Gracious and The Most Merciful

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ABSTRACT

Photovoltaic system is one common commercial device that contributes for renewable energy. It has been used widely for a past few years ago and still been research for the enhancement to achieved best performance and efficiency towards of future needs. This project proposes a modeling and control Stand alone Photovoltaic system using voltage mode control DC converter method to overcome the difficulty of using MPPT algorithms. This system is design based on parameter of commercial photovoltaic datasheet while the voltage mode control used to model power converter. Important part in generating power from Photovoltaic system is to produce constant response under uniform irradiance. Instead of using MPPT, this proposed technique was chosen to produce constant voltage. The modeling system will be constructing and simulate using Matlab Simulink to make a comparison between this two method. Anticipation from this modeling is to get the similarity and differences between proposed method and conventional method. As the result, the similarities had been defined that it can be implemented to produce maximum power. As the consequences, this proposes method might be implemented in two conditions under uniform irradiance and temperature and different irradiance. Under different temperature the performance of PV attached with MPPT technique and the proposes techniques get obviously different due on performance.

ABSTRAK

Sistem photovoltaik adalah satu peranti komersial yang menyumbang ke arah pembaharuan tenaga. Ia telah di gunakan secara meluas sejak beberapa tahun lepas dan kajian masih lagi di jalankan untuk mencapai tahap kecekapan dan prestasi yang bagus untuk kegunaan masa hadapan. Projek ini mencadangkan satu model dan system kawalan photovoltaik dengan menggunakan kaedah mod kawalan voltan DC penukar untuk mengatasi kesukaran menggunakan algoritma MPPT. Sistem ini di reka berdasarkan parameter photovoltaik komersil manakala mod kawalan voltan digunakan sebagai penukar kuasa di dalam model tersebut. Untuk menghasilkan kuasa daripada photovoltaik, perkara yang paling utama adalah untuk menghasilkan pulangan („response“) yang malar dibawah kecerahan yang seragam. Di sebalik penggunaan MPPT, teknik yang telah dicadangkan ini telah dipilih untuk menghasilkan voltan keluaran yang malar . Set model dan kawalan ini akan di bina dan di simulasikan dengan menggunakan “Matlab simulink” untuk membuat perbandingan di antara kaedah yang dicadangkan atau dengan kaedah sedia ada. Daripada permodelan ini persamaan dan perbezaan antara kaedah yang di cadangkan dan kaedah konvensional telah ditentukan bahawa kaedah yang dicadangkan boleh diguna pakai. . Sebagai kesimpulan daripada keseluruhan projek ini, dapat disimpulkan bahawa permodelan PV model BP340 dapat dihasilkan mengikut ciri-ciri nya serta kaedah yang dicadangkan ini boleh di guna pakai untuk keadaan ujian di bawah suhu dan pancaran cahaya yang seragam serta dalam keadaan perubahan pancaran cahaya yang berbeza tetapi tidak pada keadaan perubahan suhu yang berbeza.

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LIST OF ABBREVIATIONS

MPPT	Maximum Point Power Tracking
PV	Photovoltaic
P&O	Perturb and Observe
<i>I_{ph}</i>	Photocurrent
R _s	Series resistance of single diode PV module
R _p	Parallel resistance of single diode PV module
P-V curves	Power versus Voltage curve
I-V curves	Current versus Voltage curves
VMC	Voltage Mode control

CHAPTER 1

INTRODUCTION

1.1 General introduction

Earth is planet that fully with the green energy source. Petroleum, coal, wind, waves, fossil fuel and sunlight a part of green energy that continuously appear for human uses. Generation of energy by using all entity are being get attract more favorable response from many researcher. Sun light is of the most important thing that useful for human and nature. It is important in sustaining the way of human nature life. Besides that, it is a very useful element in generating of electrical energy through the contribution of concentration light. Instead of the contribution on human life, it is also one source of energy that always continuously appear in our daily day and also available in free condition.

Through that, many research are had been build up on solar energy to make it the free energy so useful for universal human life. Other than that, it is free from pollution and easy to have in daily day. Instead of in solar energy development have a few limitations on climate and highly cost, it still worth it for future. There are many type of solar energy technology such as , solar thermal and solar photovoltaic .Through solar energy , the process of produce an energy are basically converted as directly from light concentration to a simple medium and directly produce and electricity without intermediate energy conversion [1].

Photovoltaic is a part of renewable energy element which is act as medium in converting the light into electricity energy. Photovoltaic system is a technology that had come out from the interaction of PV cell regarding to the conversion medium of sun light to electricity energy. From the discrete device of PV cell it will arrange to make an array of cell, then form to be a module. Through the module, it will attach to a component of converter, battery and load to build a structure of system. Instead of the advantages, PV systems have a few drawbacks that has related to performance of system. These are due on the irradiation situations and weather itself which has a major contribution on PV efficiency and performance. Based on that, many research and studies had done in term of enhancement in photovoltaic system generation.

An important part in generating power from Photovoltaic system is the ability to produce constant response under uniform irradiance. PV cell itself has their own unique characteristic based on the point of V-I and P-V curves characteristic. Much method had introduced toward that, one of that is Maximum Power Point Tracking (MPPT). By using MPPT techniques, these techniques will lead the unique point to move near of the maximum power point (MPP) to have the optimum of maximum power and efficiency. The operation of MPPT is depend on the calculations model that well known as algorithms. Instead of using that MPPT method approached, the possibilities in using other method need to be thinking. The voltage mode control DC converter is one method to produce constant DC voltage even have variations of input voltage. This project proposes to the possibilities of implement it and comparison would be made through that.

1.2 Problem Statement

Renewable energy is something always is taught in this era. Sun light is one of renewable energy that involved producing energy. Photovoltaic is devices that commonly being used as a medium in converting a light to produce an electricity energy when exposed to the irradiance of sun light .Photovoltaic are widely use in this

field of renewable energy. These devices build by semiconductor cells (wafers) which have functionality on converting the sunlight direct current electricity [2].

When light strike to the surface of photovoltaic panel array the high maximum power can be generate. It is a maximum power due to the maximum operating point of photovoltaic model. To extract the appropriate value of the maximum power, many technique are been introduced in this field. There are a few techniques to achieved high performance on producing a maximum power. Some techniques are called Maximum point power tracking (MPPT). MPPT is a device that had a capability on producing maximum power from photovoltaic array. Otherwise, MPPT technique provides too many algorithms, so that this project proposed to modeling and control standalone photovoltaic system using constant voltage mode control DC converter method to overcome the difficulties of using MPPT techniques. In fact, this project proposed to facilitate method of modeling and control on PV system.

1.3 Objective and Scope

1.3.1 Objective

The main objective for this project is to model and control stand alone PV system using voltage mode control approach. Second objective is to simulate photovoltaic panel with boost converter. The last objective is to analyze a comparison between two methods which is constant voltages mode control and maximum power point tracking technique.

1.3.2 Scope

To achieve the objectives, there are several scopes that had been outlined. This project is more focusing on modeling and control photovoltaic model based on BP 340 commercial Photovoltaic parameter, simulate the whole process method using pure resistive load, simulate a photovoltaic model using Matlab Simulink without connected of battery charger or charge controller and the last scope is, study the comparison between proposed method and Perturb and Observe (P&O) MPPT algorithms methodology.

1.4 Outline of Thesis

This written thesis carries out five chapters. The first chapter outline is consisting on objective, problem statement, and scope of project and summary of this project. The next chapter will consist on literature review of this related project and related theory of these studies. For more, chapter two will define a photovoltaic system, PV array, types and generation techniques of performance in PV system also Maximum Power Point Tracking (MPPT) algorithms including the constant voltage mode techniques in boost converter as the modeling theory.

Furthermore, chapter three the thesis will explain on the methodology of this project whereas as fundamentally, these projects carry out by simulation in Matlab simulink. Meanwhile, for chapter four it will covered on result and discussion analysis of project and the last chapter will explained on conclusion also recommendation.

CHAPTER 2

LITERATURE REVIEW

2.1 Photovoltaic System

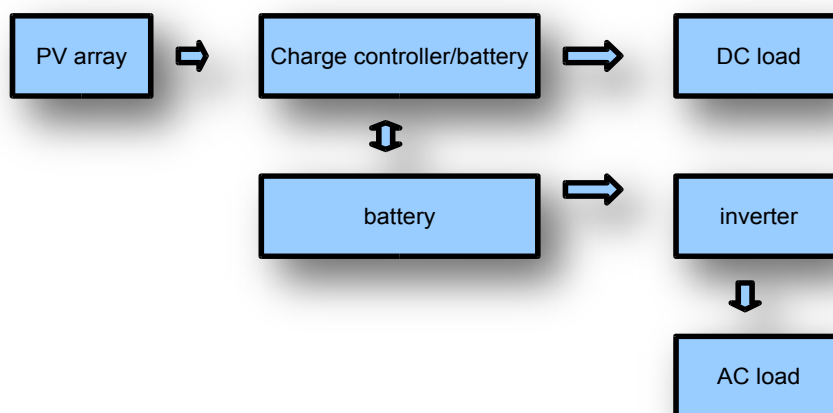
The large quantity of Sun light gives a lot of opportunity to the rising of solar photovoltaic power system. Nowadays, solar energy system has been rapidly used around the world for multiple powering of common applications. Photovoltaic effect had been found by Edmund Becquerel, who was a French scientist late 1839[3]. The irradiance of sun light is consisting of photons, and energy, so it will produce an effect when there are reaction between the sun and the photovoltaic cell.

Photovoltaic system architecture is based on a several item. It is consisting of multiple of cell which builds by semiconductor material (basically silicon) and arranged in a serial and parallel array to come out as one module. Then Photovoltaic (PV) will be put together to form a large system in order to generate large power. The photovoltaic is device that effectively effect from the potential development between two disparate materials when common junction is shed light on with radiations of photons. Then it works by smallest part of photovoltaic which is photovoltaic cell that works as converting light directly into electricity [4]. The electricity energy then stored in solar cell , or used directly by stand-alone PV system or fed into a large electricity grid powered by central generation plant (grid connected) or combine with one more than one domestic electricity generators to be feed into small grid such hybrid plant [5].

2.1.1 Photovoltaic Stand-alone system

There are many types of photovoltaic system that can be categorized through out their functionality or requirement of operations. It can be used in DC and AC power modes and available to operate as organized with electric utility grid. A few type of PV system is including of grid connected of PV system, stand alone PV systems, direct coupled system and other.

Stand- alone system is basically not attach with other electricity sources. It specifically designs to operate independently to supply DC/AC electrical loads. The system is design by appropriate size to cope with the total load demand with no additional add-on source. The photovoltaic system modules form as an array and then generates power requirement for all loads [5]. Figure 2.0 shows the typical block diagram of stand -alone photovoltaic system.



(a)