PERIPHERAL INTERFACE CONTROLLER (PIC) BASED MAXIMUM POWER POINT TRACKING (MPPT) ALGORITMA FOR PHOTOVOLTAIC (PV) DC TO DC BOOST CONTROLLER

EFFENDY ONN BIN SIAM

MASTER OF ELECTRONIC ENGINEERING (ELECTRONIC SYSTEM)

2016

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Faculty of Electronic and Computer Engineering

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EFFENDY ONN BIN SIAM

A thesis submitted
in fulfillment of the requirements for the degree of Master of Electronic Engineering
(Electronic System)

Faculty of Electronic and Computer Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2016

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DECLARATION

I declare that this thesis entitled "Peripheral Interface Controller (PIC) Based Maximum Power Point Tracking (MPPT) Algorithma for Photovoltaic (PV) DC to DC Boost Controller" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ……

Name : Effendy Onn Bin Siam

Date : ……

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APPROVAL

I hereby declare that I have read this dissertation/ report and in my opinion this dissertation/report is sufficient in terms of scope and quality as a partial fulfillment of Master of Electronic Engineering (Electronic System).

Signature : ……

Supervisor Name : Dr. Zamree Bin Abd. Ghani

Date : ……

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DEDICATION

To my beloved Mother, Father, Wife and all my Family

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ABSTRACT

This report is about to develop of Maximum Power Point Tracking (MPPT) algorithma for photovoltaic (PV) by using Peripheral Interface Controller (PIC). PV Module is a photovoltaic system that uses the photovoltaic array as a source of electrical power supply. Every photovoltaic (PV) array has an optimum operating point, called the maximum power point, which varies depending on PV temperature, the insolation level and array voltage. The function of MPPT is needed to operate the PV array at its maximum power point. The design of a MPPT is proposed utilizing a boost-converter topology. Solar panel voltage and current are continuously monitored by a closed-loop microprocessor based control system, and the duty cycle of the boost converter continuously adjusted to extract maximum power. The design consists of a PV array, DC - DC Boost converters (also known as step-up converters) and a control section that uses the PIC18F4550 microcontroller. Thus, the output voltage from DC-DC boost converter will be boost up approximately to 60V DC output voltage from load and should minimize in ripple voltage and tends to reach constant DC output voltage. Therefore, the conversion of sustainable energy from Photovoltaic (PV) system and step up by DC-DC boost converter circuit will be capable utilize large amount of output voltage. The control section obtains the information from the PV array through microcontroller's Analog to Digital Converter (ADC) ports and hence to perform the pulse width modulation (PWM) to the converter through its Digital to Analog Converter (DAC) ports. Many such algorithms have been proposed. However, one particular algorithm, the constant voltage method, claimed by many in the literature to be inferior to others, continues to be by far the most widely used method in commercial PV MPPT's. The microcontroller is programmed with a simple and reliable MPPT technique.

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ABSTRAK

Laporan ini adalah untuk membangunkan Maimum Power Point Tracking (MPPT) algorithma untuk photovoltaic (PV) dengan menggunakan Peripheral Interface Controller (PIC). Modul PV adalah sistem photovoltaic yang menggunakan pelbagai photovoltaic sebagai sumber bekalan kuasa elektrik. Setiap PV mempunyai sebuah tempat operasi optimum, dipanggil titik kuasa maksimum, yang berbeza-beza bergantung kepada suhu PVt, tahap insolation dan voltan pelbagai. Fungsi MPPT diperlukan untuk mengendalikan pelbagai PV pada titik kuasa maksimum. Reka bentuk MPPT yang dicadangkan menggunakan topologi rangsangan-converter. Solar panel voltan dan arus sentiasa dipantau oleh sistem kawalan gelung tertutup mikropemproses berasaskan, dan kitar tugas rangsangan penukar berterusan diselaraskan untuk mengeluarkan kuasa maksimum. reka bentuk ini terdiri daripada pelbagai PV, DC - DC penukar Boost (juga dikenali sebagai penukar voltan Tinggi) dan bahagian kawalan yang menggunakan pengawal mikro PIC18F4550 itu. Oleh itu, voltan keluaran dari DC-DC penukar rangsangan akan meningkatkan sehingga kira-kira untuk 60V DC voltan keluaran dari beban dan harus mengurangkan voltan riak dan cenderung untuk mencapai berterusan DC voltan keluaran. Oleh itu, penukaran tenaga lestari daripada sistem Photovoltaic (PV) dan meningkatkan oleh DC-DC litar rangsangan converter akan mampu menggunakan jumlah besar voltan output. Bahagian kawalan mendapatkan maklumat daripada pelbagai PV melalui Analog mikropengawal untuk Digital Converter (ADC) pelabuhan dan dengan itu untuk melaksanakan modulasi lebar denyut (PWM) untuk penukar melalui Digital kepada Analog Converter (DAC) pelabuhan. Banyak algoritma tersebut telah dicadangkan. Walau bagaimanapun, satu algoritma tertentu, kaedah voltan malar, yang didakwa oleh banyak dalam penyelidikan, terus menjadi setakat ini kaedah yang paling banyak digunakan di PV komersial MPPT ini. Mikropengawal diprogramkan dengan teknik MPPT yang mudah dan boleh dipercayai

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LIST OF ABBREVIATIONS

PV	–	Photovoltaic
MPPT	–	Maximum Power Point Tracking
IC	–	Integrated Circuit
DC	–	Direct Current
FPC	–	Full Power Converter
PPC	–	Partial Power Converters
S-PPC	–	Series connected Partial Power Converters
P-PPC	–	Parallel connected Partial Power Converters
CCM	–	Continuous Current Mode
DCM	–	Discontinuous Current Mode
E.M.F.	–	Electro Motive Force
A/D	–	Analog to Digital
D/A	–	Digital to Analog
IGBT	–	Insulated Gate Bipolar Transistor

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CHAPTER 1

INTRODUCTION

Lately the exploratory and open mindfulness on ecological and energy issues has acquired real interests to the examination of cutting edge innovations especially in very effective innovation [1]. Energy is an essential component for the social and monetary advancement of the social orders. The use level of energy means that the financial flourishing of a country. In Malaysia, the developing industrialization and expanding way of life has extensively expanded the use of energy. Malaysian energy utilization has risen significantly in the course of recent years because of the joined requests of industrialization and urbanization [1]. Because of expanding the energy utilization, there has been a developing worry about energy utilization and its unfriendly effect on the earth. Normal and productive usage of energy assets bears exceptional significance too. The point of the exploration is to examine the energy request, supply, utilization, ecological effect and also audit the future energy assets.

1.1 Energy Situation in the World

Energy is the key information and fundamental requirement for the development, monetary development, mechanization and modernization [2]. Accordingly, worldwide energy requests are expanded quickly and this worry is tended to universally to satisfy the interest of energy for the future world. Figure 1.1.1 demonstrates the world promoted power

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request. Politically influential nation request ascends from 145 billion MW in 2007 to 218 billion MW in 2035 (i.e. increments by 49 %).

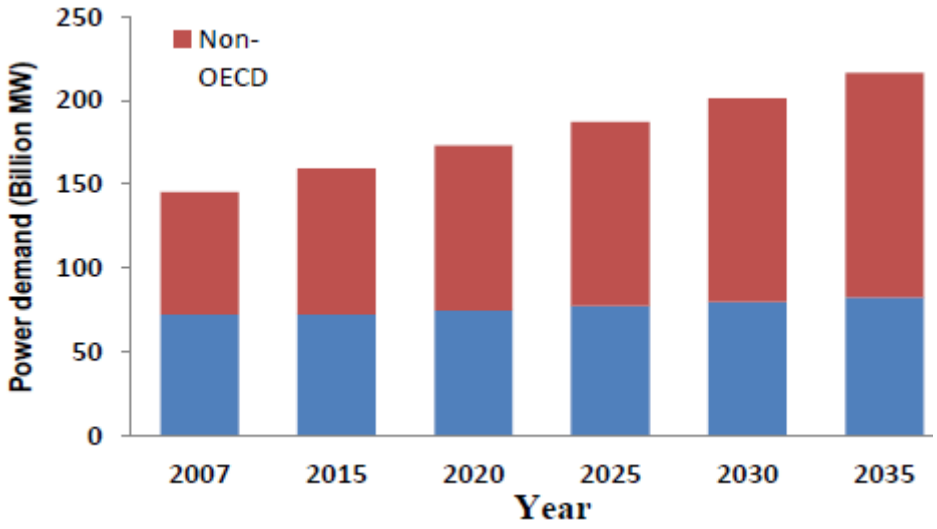

Figure 1.1.1 World Marketed Power Demand [1]

1.2 Energy Situation in the Malaysia

Malaysian is one of the fast economic growing as well as industrial countries. Figure 1.2.1 shows the overall power demand in Malaysia. Due to fast industrialization, the overall power demands from 1990 to 2009 in Malaysia is increased about 3 times from 1990 to 2009. As a result, the power plant installation also increases. The power plant capacity is increased from 14,291 MW to 24,377 MW between 2000 to 2009 [1].

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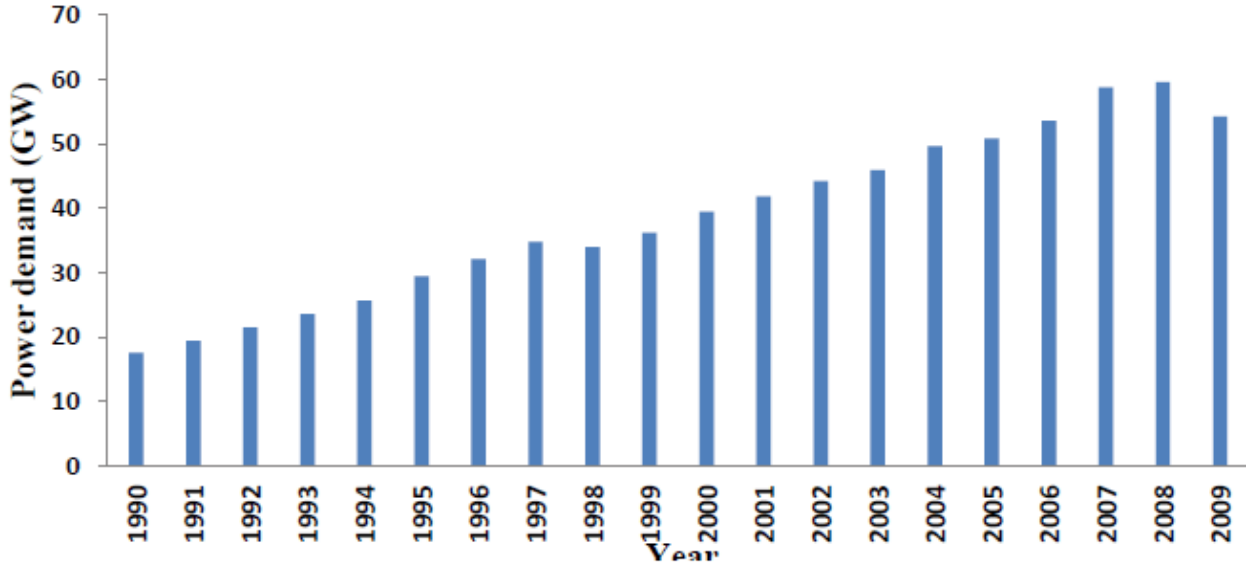

. Figure 1.2.1 Overall Power Demand in Malaysia [1]

The industrial sector also one of the major energy users in Malaysia. The industrial power demands from 1990 to 2009 in Malaysia are shown in Figure 1.2.2. The power demand increasing rate of industrial sector was higher compared to whole Malaysian demand increasing rate between 1990 and 2009 [1].

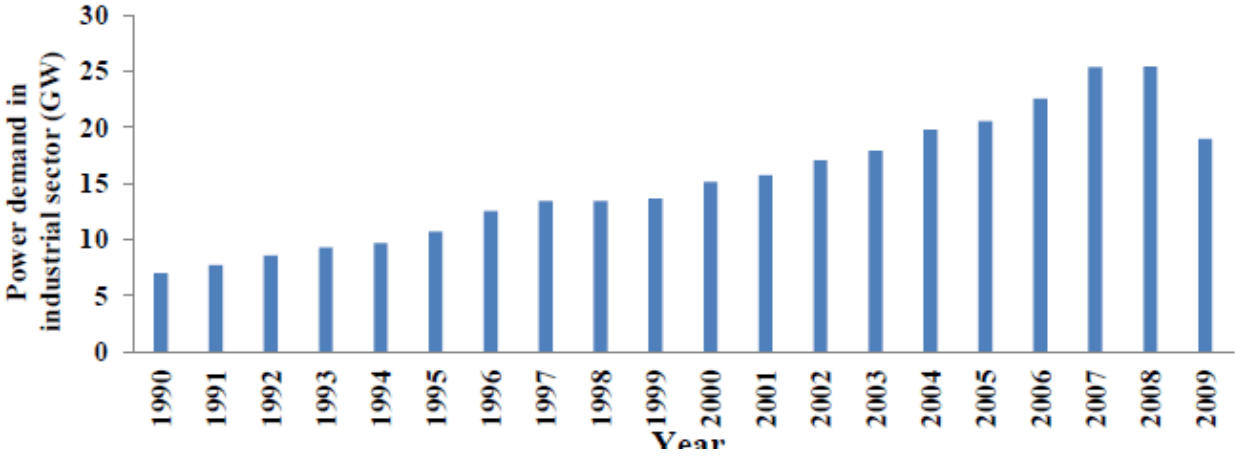

Figure 1.2.2. Power demand in industrial sector in Malaysia [1]

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Due to the economic crisis, the energy consumption in the industrial section has been decreased in 2009 compared to 2008. As industrial sector is one of the major energy consumers, this economic crisis affect the overall energy consumption in Malaysia. The overall energy consumption is less in 2009 compared to the year of 2008.

1.3. Energy and Emissions

Figures 1.3.1 and 1.3.2 show Malaysian power era limit. From these Figures, it is found that power era is mostly relies on upon the fossil fuel that produces colossal measure of emanations and changes the atmosphere. Environmental change is an imperative natural issue which possibly prompts ascends in ocean levels, loss of seaside area, and biological movements. A noteworthy reason for environmental change is discharges of nursery gasses [2]. Be that as it may, to satisfy the energy request, energy era segment add to the natural corruption (i.e. outflow, air contamination, corrosive downpour, environmental change and so forth.) [3]. The Intergovernmental Panel on Climate Change [3] reported that the colossal and major issue for the earth of its a dangerous atmospheric deviation. To spare the earth by checking an unnatural weather change has turned into a typical mission of all mankind [3]. With a specific end goal to the reaction this test, eco-effectiveness methodology is drafted to control an emanation [3]. Discharges discharge by the copying of fossil fills have a genuine nursery impact (i.e. corrosive downpour, ice liquefying, temperature ascends) on humanity [4]. Progressively the energy utilized, increasingly the CO2 discharge [10]. Since the emanations is straightforwardly relies on upon the utilization of fossil fuel, so diminishment of energy utilization is the immediate method for control discharge's issue [5].

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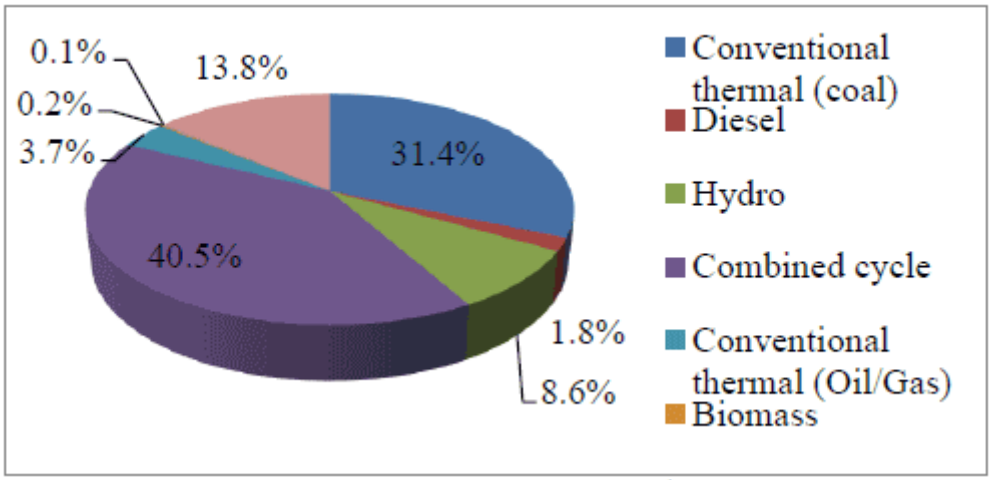

Figure 1.3.1 Malaysia installed capacity as of 31st. December 2009 [1]

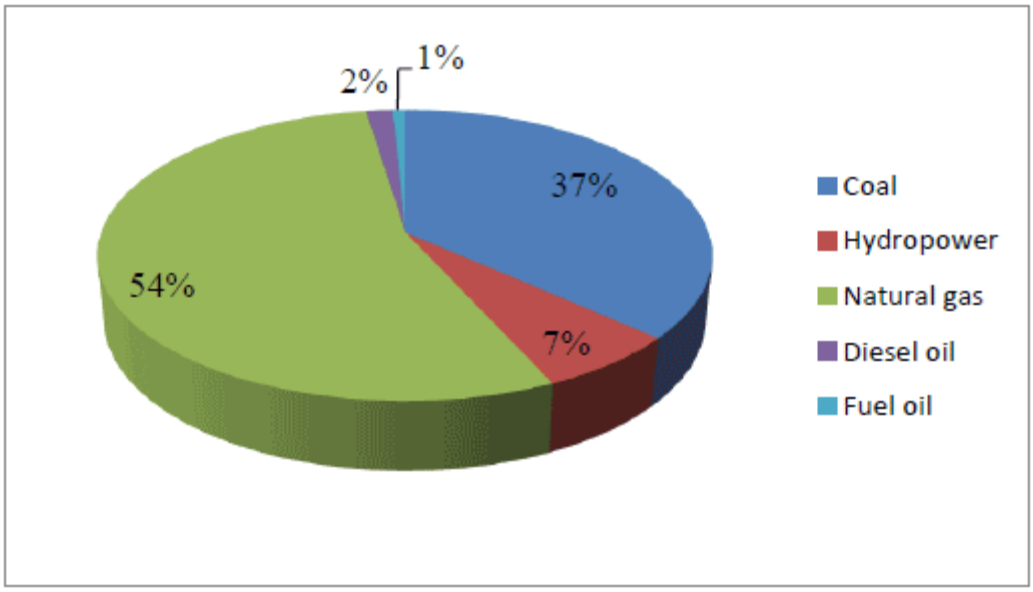

Figure 1.3.2 Energy input in PowerStation [1]

1.4. Renewable Energy Potentiality in Malaysia

Known energy sources are depleted quickly because of expanding the energy utilization. Along these lines, elective energy sources are particularly essential for the future energy request. In the late years, renewable energy is exceptionally prevalent in numerous nations. Among the renewable energy sources, sun oriented energy is the most potential

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