WIND GENERATOR

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Abstract

Wind is the one of the source of electricity distributed generation technology. Nowadays around entire worldwide can produce power by Alternating Current (AC) generator that is a common practice thus the implementation of wind generator. Sea breezes and land breezes can be important factors in a location's prevailing winds. At UMP campus Kuala Pahang it the one strategy places to generate the wind generator because it is near the sea. The advantages to use wind generator is environmental friendly refers than portable generator. As practically, wind generator doesn't use any raw material. But, portable generator uses the fuel or petrol to generate the electricity. On the other hand, by using wind generator we will cut cost during running the system compare to the portable generator. In wind generator system, the output will be producing 120Watt to directly use to consumer. The system will be controlled by PIC microcontroller that controls the input signal (120Watt) directly to user. However, when the input signal is not produce 120Watt, the PIC microcontroller will give the signal to battery backup to user. Other than that, the battery will be inverting the source from Direct Current (DC) to Alternating Current (AC) before transfer to user.

Abstrak

Angin merupakan salah satu daripada sumber yang boleh penjanaan elektrik dengan menggunakan sistem berteknologi. Sekarang, seluruh pelusuk dunia boleh menghasilkan arus ulang-alik daripada generator di mana ia sering digunakan pada generator angin. Bayu laut dan bayu darat merupakan faktor utama untuk menghasilkan angin. Di kampus Universiti Malaysia Pahang merupakan tempat yang strategik untuk menempatkan generator angin kerana ia berhampiran dengan pantai. Kelabihan menggunakan generator angin ialah mesra alam berbanding generator yang menggunakan bahan bakar. Secara praktikalnya, generator angin tidak menggunakan bahan bakar untuk menghasilkan arus elektrik. Erti kata lain, dengan menggunakan generator angin kami akan memotong kos penggunaan selama menjalankan sistem ini berbanding dengan generator mudah alih. Dalam sistem generator angin, keluaran dapat menampung sehingga 120 watt untuk langsung digunakan untuk pengguna. PIC microcontroller akan mengawal signal masukkan (120w). Sekiranya keluaran voltan tidak mencukupi, PIC microcontroller akan member isyarat kepada batteri untuk menyokong bebanan yang digunakan. Pada masa yang sama, bateri akan menukar arus terus kepada arus ulang alik melalui litar inverter sebelum digunakan.

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CHAPTER 1

INTRODUCTION

1.1 Chapter Overview

Wind generator is commonly used in many windy places. Wind turbines are used to generate electricity from the kinetic power of the wind. Historical they were more frequently used as a mechanical device to turn machinery. There are two main kinds of wind generators, those with a vertical axis, and those with a horizontal axis. Wind turbines can be used to generate large amounts of electricity in wind farms both onshore and offshore. Therefore, this type of wind turbine is mainly considered and many diagnostic procedures are proposed from consumer. It will uses in applications in a wide range of operating areas, due to their simple design, high efficiency, rugged and less costly. The title of this project is Wind generator 120 Watt. In generally, the east costal area is high potential to build up the wind generator to produce such a voltage supply (alternating current) to consumer. For this project, I have been developing the high cost wind generator to low cost wind generator.

1.2 Problem Statement

Nowadays, the many types of the electrical equipment are often used at home. However, with use often, it causes an increase in electricity bills at home. Electricity bill can be reduced by using wind generators and it should be used widely in Malaysia. Waste the using wind energy means we are wasting away money for free.

Most manual generator requires manpower to move the generator. In addition, manual generator requires raw materials such as oil to move the generator. With a simple method, wind generator can move without the need for manpower and automatically works.

Lastly, with the renewable energy, we can reduce environmental pollution including smoke and sound pollution. Compare with of the manual generator that was causing the pollution that can harm the environment.

1.3 Objective

The main point of this project is to store the energy from the wind into the battery and to convert the DC voltage to AC voltage by using power electronic devices. In order to achieve the single phase AC voltage, it required to design and create the suitable inverter for the load. To achieve all the objectives of this project, a lot of work must be consider before the project done. There are the states below:

i. To develop the generator for wind turbine and develop the low cost of generator for wind turbine.

ii. To develop the electrical control circuit that for automatically in system of generator in wind turbine.

iii. To develop the generator that produce power by using clean renewable energy.

1.4 Scope of the project

The three scopes that have been come out from this project were shows below:

i. This project is use to develop the low cost for wind generator. That mean, by using the low cost material to create the wind generator that produce 120 watt of supply power.

ii. Programmable Integrated Circuit (PIC) will be used for control system of this wind generator and also easy to add some features of this project.

iii. By using a rotating blade that to generate electricity from the kinetic power of wind energy into power source.

CHAPTER 2

LITERATURE REVIEW AND THEORY

2.1 Introduction

This chapter includes all the paper works and related research as well as the studies regards to this project. The chapter includes all important studies which have been done previously by other research work. The related works have been referred carefully since some of the knowledge and suggestions from the previous work can be implemented for this project. Literature review was an ongoing process throughout the whole process of the project. It is very essential to refer to the variety of sources in order to gain more knowledge and skills to complete this project. These sources include reference books, thesis, journals and also the materials obtained from internet.

2.2 Literature review

2.2.1 Wind Energy

Wind power energy is the conversion of wind energy into a useful form of energy, such as using wind turbines to make electricity, wind mills for mechanical power, wind pumps for pumping water or drainage, or sails to propel ships. Global wind energy resources are up to 53,000 billion kilowatts, which is equivalent to 2 times of the electric demand in the world. [1] The annual energy in the wind at a given location depends on the wind-velocity-duration distribution, which, in general, can be expressed mathematically as a Weibull function, which involves two parameters, i.e. a shape parameter and a characteristic speed. In strong winds, the power output could be limited by only covering part of the blades. With a diameter, typically, of about 25 m, the traditional windmill could deliver a shaft power output of about 30 kW in a wind speed of about 7 m/s (force 4): in a well exposed location, it would give an average power output of about 10 kW, corresponding to an energy output of about 100 kWh per working day. [2]

2.2.2 Wind Generator

The EESG is usually built with a rotor carrying the field system provided with a DC excitation. The stator carries a three-phase winding quite similar to that of the induction machine. The rotor may have salient poles or may be cylindrical. Salient poles are more usual in low-speed machines and may be the most useful version for application to direct-drive wind turbines. [4] To increase the efficiency, to reduce the weight of the active parts, and to keep the end winding losses small, direct-drive generators are usually designed with a large diameter and small pole pitch. Compared with the traditional electrically excited synchronous generator, the requirement of a larger pole number can be met with permanent magnets which allow small pole pitch. [3]

2.2.3 Turbine Modeling

In general, most large 3-bladed horizontal axial wind turbines are designed to operate at the maximum aerodynamic efficiency, *Cp* max at tip speed ratios between = 6 − 8 *opt* l . The maximum aerodynamic efficiencies typically vary between 0.4 and 0.5 [6]. According to the design principle of the maximal wind energy capture, the rotor diameter *D* and the designed rated wind speed *r v* of wind turbines can be derived as a function of rated rotor speeds and rated power levels. [4]

$$D = \sqrt{\frac{8 \times P_T}{\pi \rho \cdot C_{p\max} \ v_r^{3}}}$$

$$n = \frac{60 \cdot v_r \cdot \lambda_{opt}}{\pi D}$$

Where, *T P* is the available rated shaft power, (kg/m3) is the mass density of air, *r v* (m/s) is the rated wind speed, and *nr* (rpm) is the rated operating shaft speed, it is also the rated rotational speed of the direct-drive PM generator. [4]

2.2.4 Battery Charger

The use of microcontrollers in battery chargers implies several advantages, as the battery intrinsic characteristics, the number of series-connected units and the load curve of the battery can be defined in the internal memory of the processor via software. Thus the charging process provides more controllable results, becoming reliable and preserving the battery life. [5][13]

An additional control loop can even be implemented in order to monitor the battery temperature, since the excessive heating in the fast-charging process may damage the battery (Figure 1). [5][13]

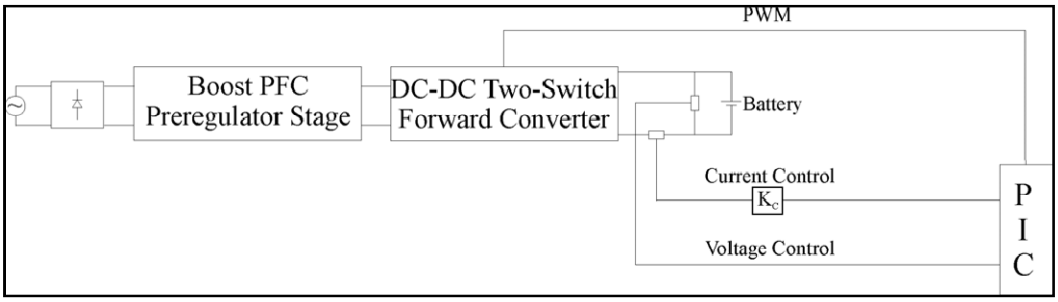

Figure1: Block diagram of the proposed battery charger

2.2.5 Battery Specification

Battery Specifications	
Parameter	**Value**
Nominal voltage	12V
Charging nominal current	4.5A
Capacity	45Ah

Figure 2: Battery specification

2.2.6 DC and AC Current

In the world today there are currently two forms of electrical transmission, Direct Current (DC) and Alternating Current (AC), each with its own advantages and disadvantages. DC power is supply the application of a steady constant voltage across a circuit resulting in a constant current. A battery is the most common source of DC transmission as current flows from one end to another. Most digital circuitry today is run off in DC power as it carries the ability to provide either a constant high or constant low voltage, enabling digital logic to process code execution. [7] the idea is used the DC supply from the battery and any devices that used today is in AC current. In this project, charge the battery by using the wind generator.

2.2.7 Inverter

Multi-input inverter has the following advantages: 1) power from the PV array or the wind turbine can be delivered to the utility grid individually or simultaneously, 2) maximum power point tracking (MPPT) feature can be realized for both solar and wind energy, 3) a large range of input voltage variation caused by different isolation and wind speed is acceptable, 4) power rating of the inverter can be reduced. [8]

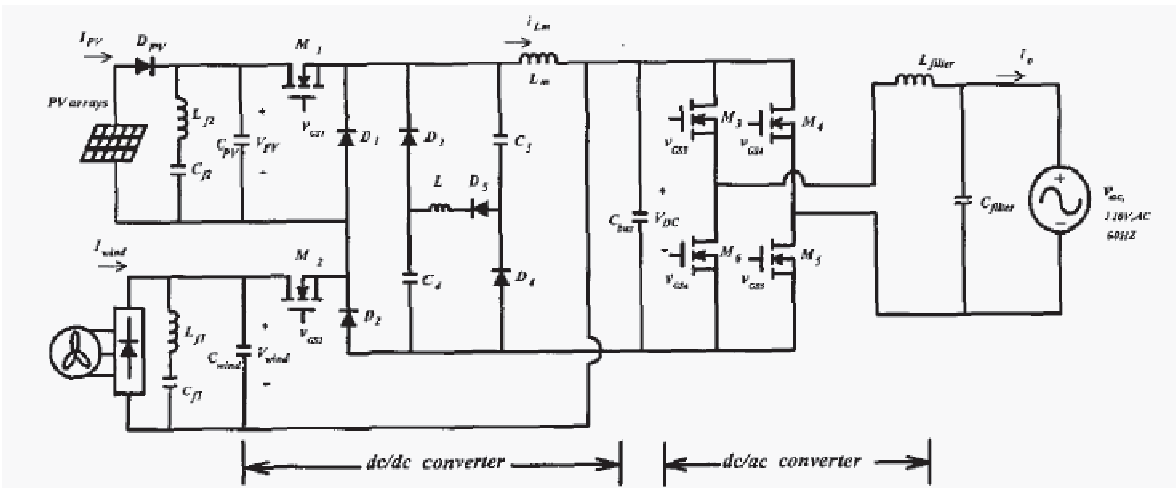

Figure 3: Multi-input inverter

2.2.8 Converter

Emulation of the wind turbine is confirmed by running the DC motor to track the theoretical rotational speed of the wind turbine rotor. A dynamic maximum power controller is implemented and tested. The controller uses the wind speed and rotor speed information to control the duty cycle of the buck-boost converter in order to operate the wind turbine at the optimum tip-speed ratio. Test results indicate that the proposed system accurately emulates the behavior of a small wind turbine system. The output of the synchronous generator was first rectified by a 3-phase rectifier and then passed through a DC-DC converter. [10]

The topology selected was the buck-boost converter, as the variation of wind speed and expected output voltage were not known in advance. The duty ratio of the converter was controlled by a microcontroller (PIC 18F4550) and the output of the buck-boost converter was connected to a dump load (RL).[9] In order to inter-connect the DC bus with the 200V AC power the DC voltage must be boosted up to about 300V using a DC-DC converter with large step-up ratio [10] [11][12]

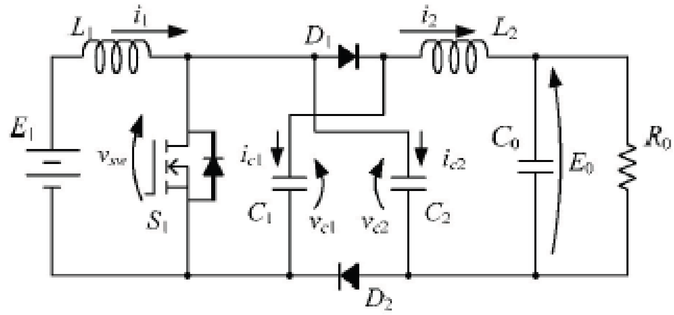

Figure 4: Converter

We can observe the two stage energy conversion, that is, inductive and capacitive energy conversions. The energy conversion in the first stage is the same as the conventional boost converter. Therefore the relation between the source voltage E1 and the capacitor voltage vci = VC2 Vc in steady state can be expressed as

$$V_C = \frac{1}{1-\alpha} E_1$$

$$\alpha = \frac{T_{on}}{T} \qquad \text{:duty ratio}$$

The energy conversion in the second stage boosts Vc further up to Eo. Using the basic property of the inductor L2 in steady state, we have

$$E_0 = (1+\alpha)V_C$$

Combining Eq.(1) with Eq.(2) gives the relation between the output voltage Eo and the input voltage El as

$$E_0 = \frac{1+\alpha}{1-\alpha} E_1$$

2.2.9 Summary

In this chapter, a new idea is found for designed the suitable circuit for this project. All of the selecting devices were shown in this chapter. Few methods have been discovering to relate it to the researcher's study. In the next chapter will present the concept, framework and all about this project completely.

CHAPTER 3

METHODOLOGY

3.1 Chapter Overview

This chapter will explain about the methods that will be done to complete the project. Basically, the project will be divided into few parts and the project will be executed stage by stage. After the title has been decided, the first thing to do is to have a clear understanding about the whole idea of the project. Besides, literature review was done on various topics like the basic knowledge about a part of wind generator and the system will using for this project.

3.2 Project management

This project was divided in two sections to complete the system of wind turbine. The flow chart is the first step to get the system follow by our design. The second step is by sketch the block diagram of the wind turbine system. These two steps have made before design the electronic and mechanical part. Also this project management has to define the basic component that use for wind turbine system.

3.2.1 Flow chart

The flow chart shown below is the method and approaches that need to be taken have been determined to make this project successful. The flow chart show the beginning of the project and the target and aim to make the wind turbine system is functioning.

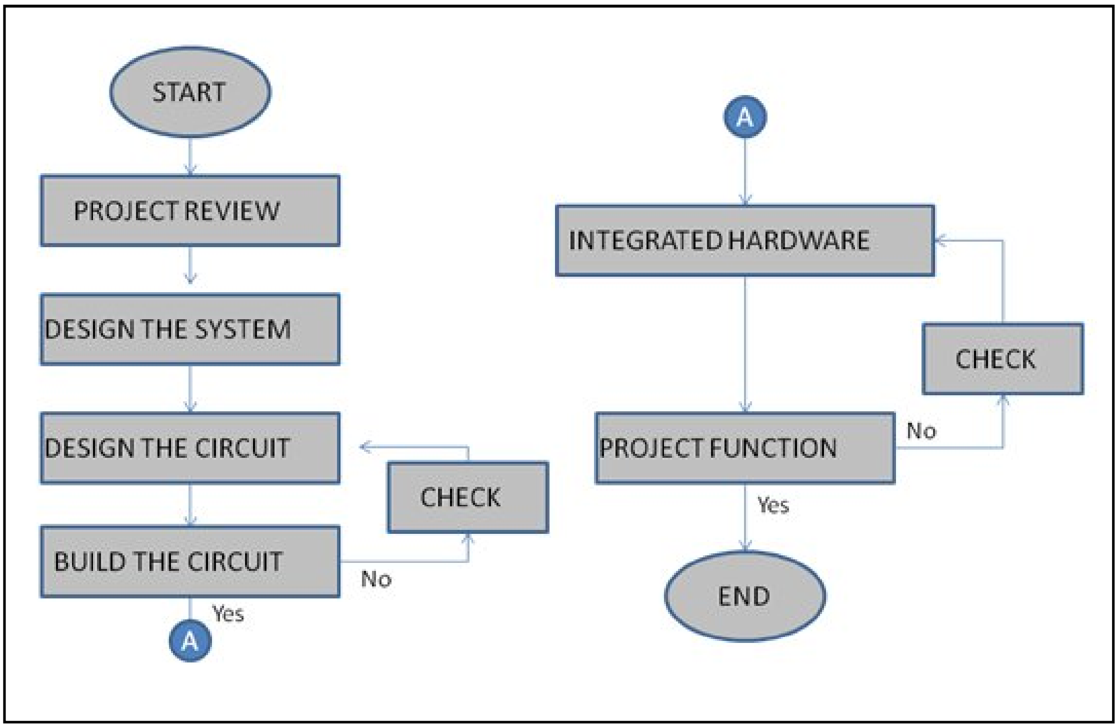

Figure 3.1: Flow chart

3.2.2 Block diagram

Block diagram is a diagram of a system, in which the principal parts or functions are represented by blocks connected by lines. For the block diagram of wind turbine system is connection by all main part of the system.

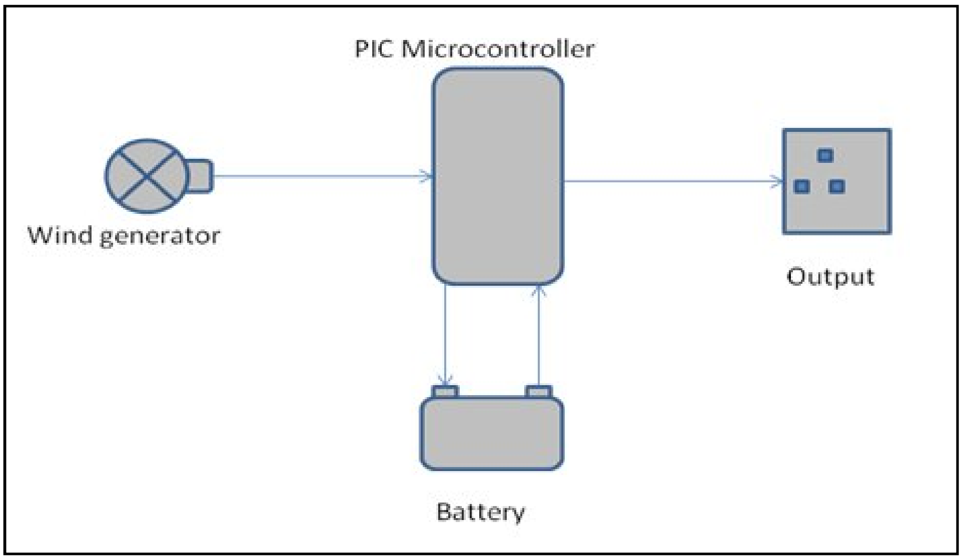

Figure 3.2: Block diagram of wind turbine.

The wind turbine system has using the generator to generate direct current to PIC microcontroller system to switching on or off to charge the battery. The output voltage can be use to consumer in the low ratting watt usage.

3.3 Hardware development

The development of the hardware is the main part of the project. The basic component is to determine the system detail in every single part to use. The basic component uses for wind turbine are alternator, battery, charge controller, inverter and load.

3.3.1 Alternator

Alternator is the electrical device that from kinetic to electrical system. In building up a wind generator, the main component is generator. The output of generator or alternator is alternating current. Figure 3.3 show the alternator that use for this project.

Figure 3.3: Alternator

To get the supply voltage, alternator car from Produa was used as the generator of this project. The system at alternator car, already convert from alternating current (AC) to direct current (DC) output.

3.3.2 Battery

Battery is a electrical storage device that uses a reversible chemical reaction to store energy. Figure 3.4 show the example of battery that use in the system of wind generator.

Figure 3.4: Battery car 12v.

Battery is a combination of one or more electrochemical cells, used to convert stored chemical energy into electrical energy. The battery has become a common power source for many household and industrial applications. For this project, battery is for charge and discharging voltage supply and transfer to consumers.

Example calculation for sizing battery:

Load = 40Wh per day

Battery capacity = 40 Ampere hour

Ampere per hour = ______________

= ___ = **2.29Ah**

Energy loss = 20%

Ampere hour per day = 2.29 + 2-%

= 2.75Ah per day

Battery required = 2.75/0.2 (energy loss)

= 13.75Ah x 7days (7 day using when no windly)

= **96.25Ah for a week**

Battery using = 12v 40Ah

Battery need = 96.25Ah / 40Ah

= 2.41

≈ **3 unit of battery**

3.3.3 Charge controller

This charge controller was design by using PIC microcontroller 18F4550 to perform charging through the battery. The charge controller will display the level of the capacity battery by using different color of LED. In additional system, charge controller using LCD display for show the value of battery and status of battery.

3.3.3.1 PIC Microcontroller

The PIC microcontroller acts like the brain of the charge controller system. The microcontroller chip that has been selected for the purpose of controlling the LCD display led and relay system.

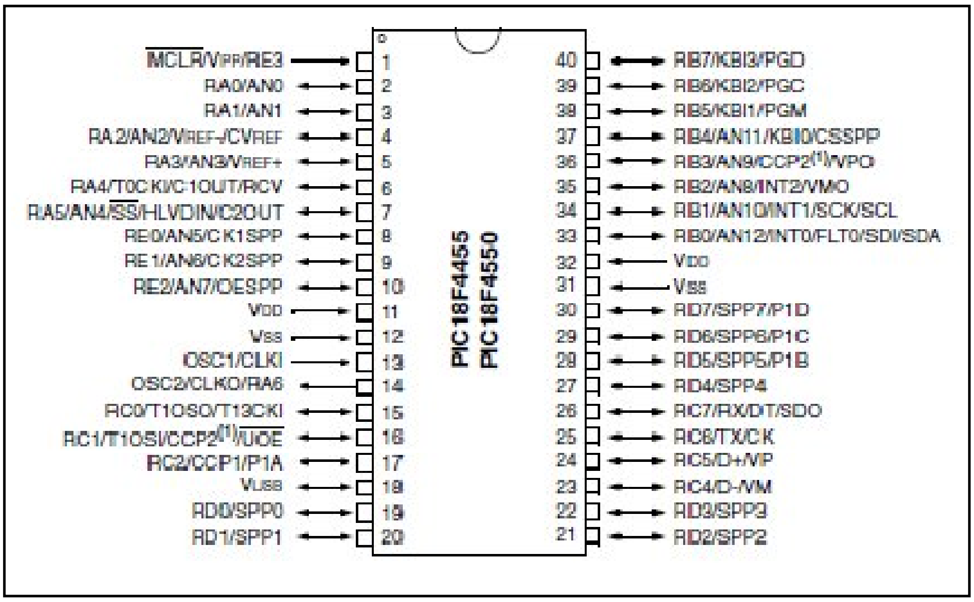

Figure 3.5: Pin diagram of PIC18F4550