WIND TURBINE CHARGE CONTROLLER

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This thesis is submitted as partial fulfillment of the requirements for the award of the Bachelor of Electrical Engineering (Hons.) (Electronics)

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JUNE, 2012

ABSTRACT

Wind energy is become the world's fastest growing energy source as it meets the environmental concern on the clean generation of electricity. Nowadays, the available wind turbines are optimized to produce maximum power output under limit of wind speeds. Conversely, universal wind turbine charger is not suitable to be used in certain area cause by the rapidly changed of the wind speeds. Throughout this project, wind turbine will be design carefully, select the appropriate battery and control the charging system by diverting excess power to a dump load (could be anything such as light bulb, water heater and etc). The wind source used in experimental will be replaced by the power supply by varying the voltage and current source to see the charging rate controlled by the wind turbine charge controller. This technique should be able to keep the wind turbine in superior performance and prevent from overcharged. Without a doubt, it is safe and economic to be executed.

ABSTRAK

Tenaga angin menjadi sumber tenaga yang paling pesat berkembang di dunia seiring dengan keprihatinan alam sekitar terhadap penghasilan tenaga elektrik yang bersih. Pada masa kini, turbin angin yang terdapat dipasaran telah dihadkan penghasilan kuasa maksimum dibawah had kelajuan angin tertentu. Sebaliknya, pengecas turbin angin tidak adalah sesuai untuk digunakan di jalan kawasan tertentu kerana perubahan kelajuan angin yang tidak menentu. Sepanjang projek ini, turbin angin akan direka bentuk dengan teliti, pemilihan bateri yang sesuai dan kawalan sistem pengecasan dengan mengalihkan kuasa yang berlebihan kepada beban (boleh digunakan apa-apa beban seperti mentol lampu, pemanas air dan sebagainya). Sumber angin yang digunakan dalam eksperimen ini akan digantikan oleh bekalan kuasa dengan mempelbagaikan sumber voltan dan arus untuk melihat kadar cas yang dikawal oleh pengawal caj turbin angin. Teknik ini boleh mengekalkan turbin angin dalam prestasi yang tinggi dan mengelakkan daripada pengecasan yang berlebihan. Tanpa ragu-ragu lagi, ia adalah selamat dan menjimatkan untuk dilaksanakan.

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LIST OF ABBREVIATIONS

COP 15	Fifteenth Conference of Parties
CO_2	Carbon Dioxide
GW	Giga Watt
TWh	Tera Watt Hour
KW	Kilo Watt
UKM	Universiti Kebangsaan Malaysia
W/m^2	Watt Per Meter Square
M	Meter
NiCd	Nickle Cadmium
Ah	Ampere Hour
UMP	Universiti Malaysia Pahang
DC	Direct Current
IC	Integrated Circuit
MOSFET	Metal–oxide–semiconductor field-effect transistor
PIC	Peripheral Interface Controller

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This chapter will present the general idea, wind power, charge controller, objectives of study, research scope, project contribution, thesis overview, project flow, and conclusion.

1.2 GENERAL

With the present situation of increasing energy demand, rising energy prices, and reinforcement of countermeasures for global warming and environment deterioration, sustainable energy sources have taken the spotlight.

The establishment of a sustainable energy future is one of the most pressing tasks of mankind for the 21st century. With the exhaustion of fossil fuel resources, the energy economy has to change from a chemical to a physical base.

Discussions on environmental problems in energy policy, particularly global warming issues, have been given much attention these days. Scientific temperature observations, begun in the 19th century, have shown that the pace of temperature increase in the latter half of the 20th century has been faster. Currently, the amount of fossil fuel origin carbon dioxide discharge has been increasing, with the corresponding increase in energy demand. Due to this increase, it has been strongly claimed that the artificial greenhouse effect is the main cause. For these global warming problems, the United Nations Framework Convention on Climate Change was issued in 1994, and Kyoto Protocol was issued in February of 2005. The protocol called for efforts to reduce the amount of greenhouse type gas emissions from in advanced countries from 2008 to 2012, ultimately aiming for 1990 levels. After the COP 15 negotiations in Copenhagen in December of 2009, one of the outcomes was that "The Copenhagen Accord recognizes the scientific view that an increase in global temperature below 2 degrees is required to stave off the worst effects of climate change". At this point the effort appears to be focused on CO_2 reduction in society. Considering renewable energy forms like wind power, their introduction has been promoted as a core program towards a low carbon social structure.

1.3 WIND POWER

Wind power 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.

Wind power is a cleaning energy and also a more safe energy when comparing with nuclear energy. There's a catastrophic example of nuclear energy presently, following an earthquake, tsunami, and failure of cooling systems at Fukushima I Nuclear Power Plant and issues concerning other nuclear facilities in Japan on March 11, 2011, a nuclear emergency was declared. Explosions and a fire have resulted in dangerous levels of radiation, sparking a stock market collapse and panic-buying in supermarkets [1] As of April 2011, water is still being poured into the damaged reactors to cool melting fuel rods. John Price, a former member of the Safety Policy Unit at the UK's National Nuclear Corporation, has said that it "might be 100 years before melting fuel rods can be safely removed from Japan's Fukushima nuclear plant" [2].

At the end of 2009, worldwide nameplate capacity of wind-powered generators was 159.2 GW. (By June 2010 the capacity had risen to 175 GW). Energy production was 340 TWh, which is about 2% of worldwide electricity usage;[3] and has doubled in the past three years. Several countries have achieved relatively high levels of wind power penetration, such as 20% of stationary electricity production in Denmark, 14% in Ireland and Portugal, 11% in Spain, and

8% in Germany in 2009. As of May 2009, 80 countries around the world are using wind power on a commercial basis.

1.4 CHARGE CONTROLLER

Basically, battery is the main component in renewable energy system. The energy generated from various renewable energy such as wind and solar. However, the frequent charging and discharge the battery will lead the battery to have short term. Thus, the important of using charge controller is the main concern in keeping the battery life longer and optimize the system. There have two main types of charge controller that is mostly used that are shunt and series regulator.

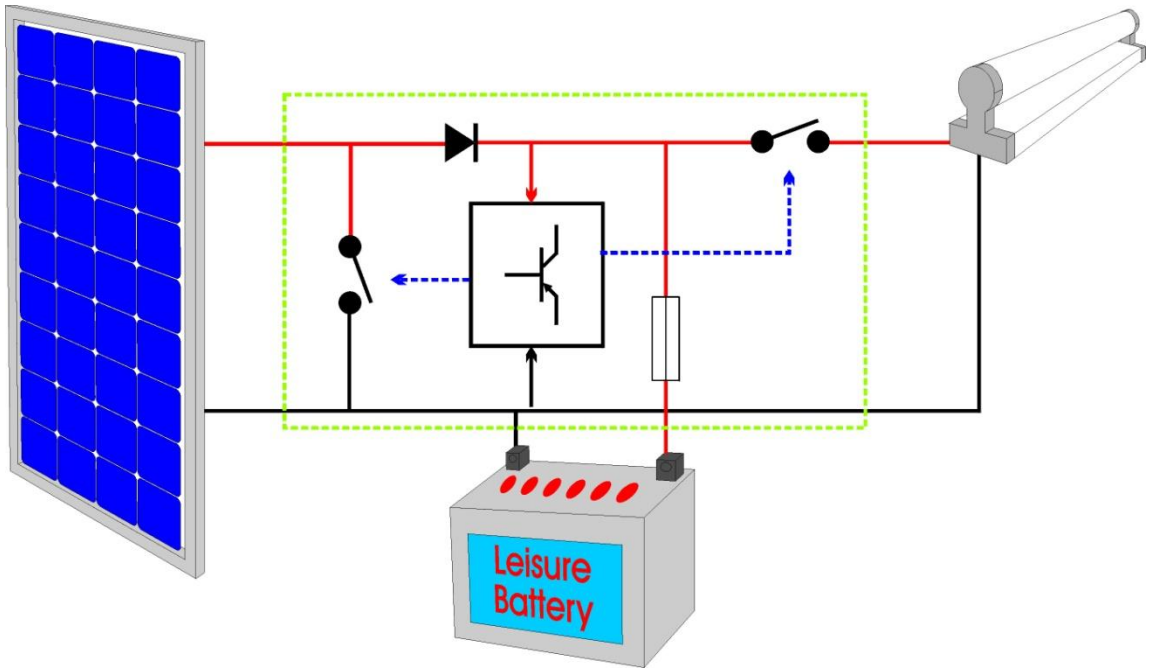

Figure 1.1: Shunt charge controller

As the battery near to full charge, current from the source will be limit by increasing the resistance of shunt element. Thus the battery voltage will remain before the dump load turn on as the battery reach to full charge. This type of charge controller is suitable to be used in wind energy system. This is because, if the battery is full charge, there still have load that will control the blade spinning not to fast which may damage the generator.

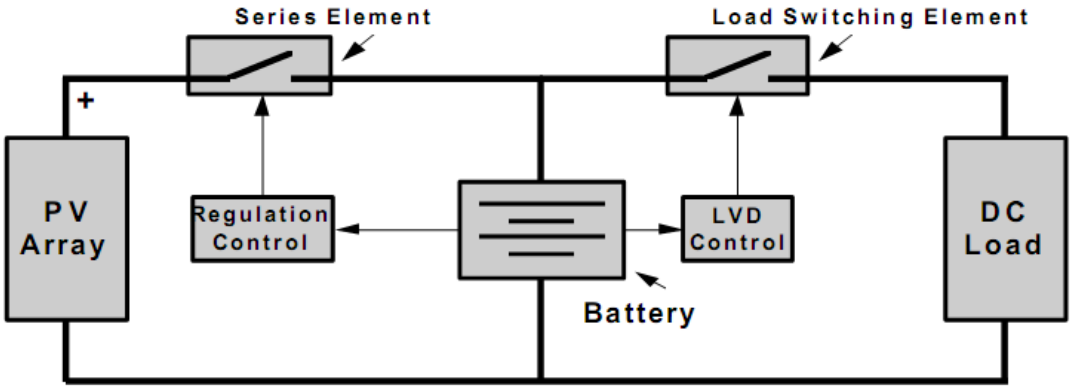

Figure 1.2: Series charge controller

As the name implies, series charge controller is work in series between source of supply and battery. The battery will be disconnected to the source once the battery reach to full charge. This type is mostly used in solar system where by simply unhooked battery from source can protect the battery to be overcharge. However, this type is not suitable to be used in wind energy system. By unhooked the battery with wind will lead the wind blade to spin without load. The spinning will easily go fast as the wind speed is high.

1.5 OBJECTIVES OF STUDY

i. To build the charge controller for wind turbine according to wind turbine specification in UMP Pekan, Pahang..
ii. To find suitable type of battery for the controller.

1.6 RESEARCH SCOPE

i. Four types of battery were compared to find the most suitable battery for the wind turbine charge controller.
ii. Pspice software will be used as simulation software to check on function of charge controller circuit.

1.7 PROJECT CONTRIBUTION

This project is mainly concern on the reducing cost of wind turbine energy system in long term. Maintaining the system without proper controller may cause

the battery frequently damage since overcharging and deep discharging repeatedly occurs. It is not proficient to keep change the battery whenever the battery damage and this controller will be function for the battery to have longer lifespan as we avoid the overcharge and deep discharge. In addition, the used of charge controller is important to prevent from safety hazard that may cause from overcharging.

Furthermore, by using shunt charge controller, it could increase the performance of the wind turbine energy system without damage the wind turbine since it connected to the dump load to avoid the rotation of the blades goes to high which may damage the wind turbine.

1.8 THESIS OVERVIEW

This Wind Turbine Charge Controller final thesis is arranged into following chapter:

Chapter 1: Basically is an introduction of the project. In this chapter, provides the general of the project, objectives, research scope, project contribution and also the thesis outline.

Chapter 2: Focuses on literature reviews of this project based on journals and other references.

Chapter 3: Mainly focused on methodologies for the development of Wind Turbine Charge Controller. Details on the progress of the project are explained in this chapter.

Chapter 4: Presents the results obtained and the limitation of the project. All discussions are concentrating on the result and performance of Wind Turbine Charge Controller.

Chapter 5: Concludes overall about the project. Obstacle faces and future recommendation are also discussed in this chapter.

1.9 PROJECT FLOW

Organization of the project is guided from project flow chart. A flow chart or flow diagram is a graphical representation of a process or system required to create output. This flow chart was present steps or process of final year project that I will present this in this semester. Figure shows that process to complete my final year project.

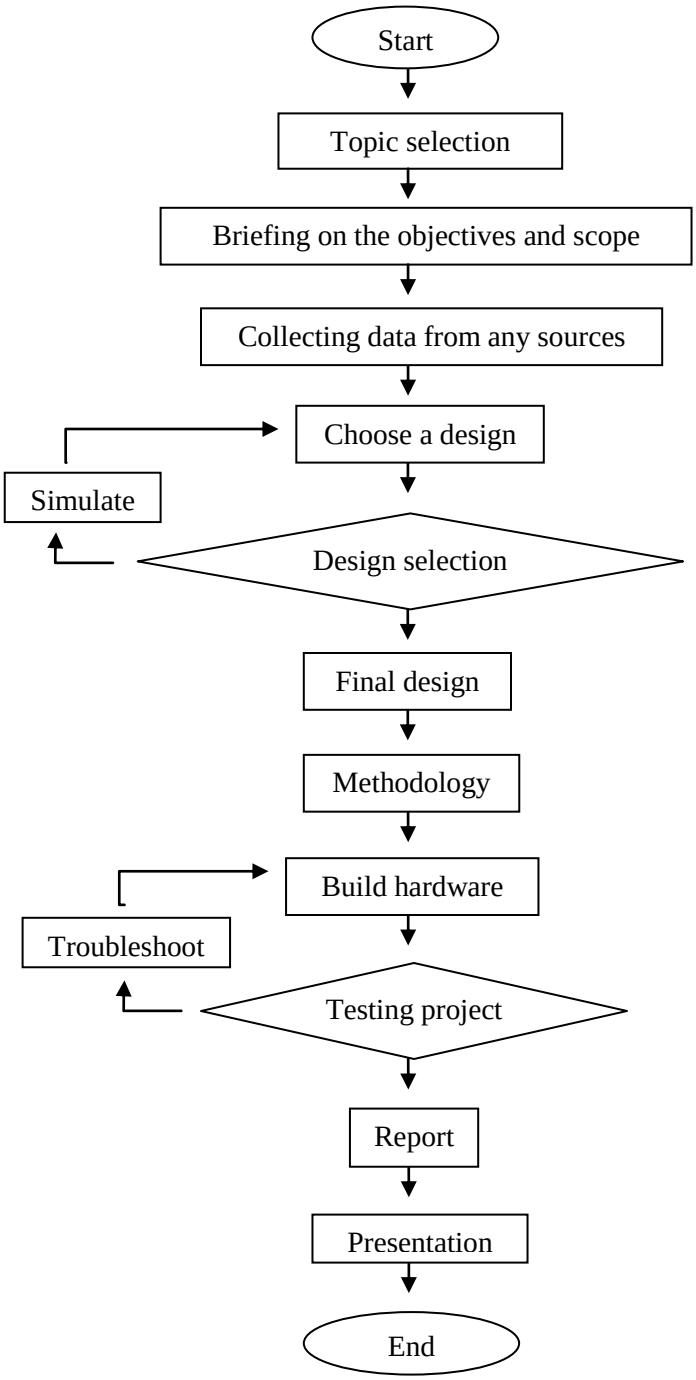

Figure 1.3: Project work flow

1.10 CONCLUSION

This chapter mainly describes the general idea of wind energy system, the objectives of this project, research scopes, and contributions of this project. The next chapter will explain more on literature review that have been done for this project.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In previous chapter already discuss the basic idea of this project, objectives, scopes and contribution of this project. This chapter will touch more on the literature review that have been done such as energy sources in Malaysia, wind energy utilization in Malaysia charge controlling systems and the types of battery.

2.2 ENERGY SOURCES IN MALAYSIA

The main energy supply sources in Malaysia are fossil fuels. Crude oil and natural gas were the dominants in 2005 and are projected to remain as the main energy supply sources in 2010. [5] However, the used of oil and gas produce green effect as

it release CO_2. The study of renewable energy in Malaysia should be widely explored to reduce the pollution causes by non renewable energy generation.

2.3 WIND ENERGY UTILIZATION IN MALAYSIA

One of the greatest challenges associated with wind power is the unpredictable character of the wind.[1] In Malaysia, wind energy conversion is a serious consideration. In present technology, wind energy in Malaysia is not suitable to generate electricity commercially or wind is not particularly good in Malaysia as compared to the UK or Denmark, but islands like Perhentian can definitely gain a lot of power especially when wind turbine is jointly equipped with solar panels–which Malaysia is rich in. In the day, when there will be less wind, the solar panels will cover the extra load and at night, the wind turbines will be the ones generating more power. A more recent research in 2005, a 150 kW wind turbine in Terumbu Layang-Layang was demonstrated with some success by a team from UKM. However, the availability of wind resource varies with location. The station located at Mersing (seaside) has the greatest potential with a mean power density of 85.61 W/m^2 at 10 m above sea level.[6]

2.4 CHARGING CONTROLLER SYSTEM

Charge controllers could be design in many ways as far as it could control the charging process and protect the battery from overcharged. Charge controller

intended for solar panels work by monitoring the battery voltage, and once it reaches full charge, the controller simply shorts the solar panel leads together. This doesn't harm the solar panels, but it does waste whatever power they're generating. The energy ends up heating the transistors in the controller.

This type of controller is not ideal for a wind generator, since shorting the output of the wind generator while it's spinning at high speed will generate a huge current spike, possibly destroying the controller and perhaps even the generator in the process. On the other hand, simply unhooking the generator from the batteries is not a good idea either, since with no load on it, the generator might over speed in a strong wind and destroy itself.

The ideal solution is to charge the batteries until they reach a full charge, then switch to an alternate load where the energy can be safely handled. Whereas, this energy could be used for some useful purpose, such as supplementing a water heater, a bank of 12 volt light bulbs and many other application.

2.5 TYPES OF BATTERIES

There have many types of battery that is available in market today. All of battery has its own characteristic that can suit to different type of application. Here is some of the rechargeable battery were discuss which is Lead Acid Battery, Lithium Battery, Nickel Cadmium Battery, Nickel Metal Hydride Battery.

2.5.1 LEAD ACID BATTERY

Lead acid charging uses a voltage-based algorithm that is similar to lithium-ion. The charge time of a sealed lead acid battery is 12–16 hours, up to 36–48 hours for large stationary batteries. With higher charge currents and multi-stage charge methods, the charge time can be reduced to 10 hours or less; however, the topping charge may not be complete. Lead acid is sluggish and cannot be charged as quickly as other battery systems.

Lead acid batteries should be charged in three stages, which are constant-current charge, topping charge and float charge. The constant-current charge applies the bulk of the charge and takes up roughly half of the required charge time. Then, topping charge continues at a lower charge current and provides saturation, and the float charge compensates for the loss caused by self-discharge. [7]