THE DEVELOPEMENT OF SOLAR POWER BOAT ENGINE

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A thesis submitted in fulfilment of the
Requirement for the award of the degree of
Bachelor of Electrical Engineering
(Power System)

Faculty of Electrical & Electronic Engineering
University Malaysia Pahang
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NOVEMBER 2010

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ACKNOWLEDGEMENT

Firstly, thank to Allah throughout all His Almighty kindness and loveliness for letting me to finish my final year project. Secondly, I wish to hand a million thanks to this final year project supervisor En. Ramdan Bin Razali for his encouragement guidance and consistent support in finishing this final year project. For my beloved father and mother that very concern about my project, I really appreciate all of those supports and idea which both of you give me. Thank you so much.

Here, I also want to thanks to UMP associates that contribute in my project progress either direct or indirect help especially En.Muhammad Ikram who support and help me to understand all about solar power system either it operation or requirement. Thank you very much again.

My fellow colleagues should also be recognized for their continuous support at any occasions. Not to forget the kindness friends who continuously support me during finishing my project. For all of that, I am very thankful to the cooperation and contribution from everyone that has driven me to accomplish this project. To wrap all this in one, thank you for everything. May Allah bless all of you.

ABSTRACT

With the increased of fuel energy demand and fear of depletion of the fossil fuel for year ahead makes most of boat user facing problem with burdened by higher cost of the fuel. Renewable energy has remarkably the only best solution for this problem. Hence, these projects proposed to solve the problem by replacing the fuel energy with the renewable solar power energy. The proposed of the solar power boat which will be consists of the solar panel (photovoltaic cell) as sunlight collector that act as the power generator that will be supported by the battery as storage power for the boat and the load which is dc motor that replace fuel engine. The charging process will be control by the solar charger controller that uses PWM operation method. Overall system will start by the sunlight converted to the electricity and then the generated power will be transferred to the battery. Then only that the load (dc motor) can be operated. Both of these charging and running the load will be operate together. With this solar power technology, we can reduce fuel usage. Moreover, these method helps reduce air pollution that produced by the fuel engine.

ABSTRAK

Dengan peningkatan penggunaan tenaga dari sumber minyak dan kebimbangan tentang minyak yang semakin sedikit untuk masa akan datang menyebabkan ramai pengguna yang menggunakan bot menghadapi masalah dangan beban yang semakin bertambah oleh kenaikkan harga minyak. Tenaga semula jadi sememangnya menjadi satu langkah yang terbaik tuntuk menangani masalah ini. Oleh itu, projek ini dicadangkan untuk menyelesaikan masalah ini dengan menggantikan tenaga dari sumber fosil dengan tenaga daripada sumber semulajadi iaitu tenaga suria. Cadangan untuk bot tenaga suria dimana ia akan menggunakan papan suria(sel photovoltaic) iaitu alat pengumpul tenaga suria yang peranannya untuk menghasilkan tenaga elektrik yang mana akan ditolong oleh bateri sebagai tempat penyimpanan tenaga dan seterusnya menggunakan motor elektrik bagi menggantikan motor yang menggunakan minyak sebagai medium operasi. Proses mengecas akan dikawal oleh alat pengawalan cas yang menggunakan cara operasian PWM. Keseluruhan proses akan dimulakan dengan penukaran tenaga suria kepada tenaga elektrik dan seterusnya elektrik yang terhasil akan dihantar ke bateri untuk disimpan. Hanya dengan ini motor dapat digerakkan. Kedua-dua proses mengecas dan menggerakkan motor akan berjalan dengan seretak. Dengan teknologi tenaga suria ini, kita dapat menggurangkan penggunaan minyak. Bukan itu sahaja, kaedah ini juga dapat mengurangkan pencemaran yang dihasilkan oleh engin bot sebelum ini.

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LIST OF ABREVIATIONS

DC	Direct Current
AC	Alternating Current
PV	Photovoltaic
PWM	Pulse Width Modulation
MPPT	Maximum Power Point Tracking
L.E.D	Lead Emitting Diode
IC	Integrated Circuit
CMOS	Complementary Metal Oxide Semiconductor
PMOS	p-channel MOSFET
LCD	Liquid Crystal Display
MOSFET	Metal Oxide Semiconductor Field Effect Transistor

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CHAPTER 1

INTRODUCTION

Fuel crisis nowadays really make anxiety to people who using fuel engine like cars, boats and motorcycles. This crisis cannot be taken lightly because many people are affected with the current fuel depletion and unstable price. Many innovations were made to overcome this problem such as using hydrogen, electric car, natural gas vehicle (NGV) and other alternative energy. Above all of the innovation, most of them focus on automobile like car. How about boat? Is there any innovation on this? The answer is yes. Currently many innovations for this transportation are based on solar power and this innovation has started a long time ago. A solar power boat consists of solar panel, battery and electric motor. Base on this idea that lead to this project and this project might give an answer to boat user on how they can reduce fuel dependent. Solar power boat is an electrical boat with clean engine that using either AC or DC motor. On the seas and inland waters as well as along their banks there are only a few connections to public electricity mains. People who live on inland waterway crafts, sailing boats, space stations and houseboats, are dependent on batteries, just as the owners of electrically propelled boats. But batteries sometimes discharge and must be replenished. One of the most elegant solutions for this is using solar power to charge the batteries. Solar array on a ship can charge the batteries on the spot - cleanly and efficiently with free energy from the sun.

1.1 PROBLEM IDENTIFICATION

Nowadays electric transportation is one of the important technology to prepare us in facing the time when the fuel source get depleted which the rate of usage increasing dramatically compare to it production year after year. Based on the graph [1] shown in figure 1.1 shows the graph of various fuel production type and it total consumption from 2008 to 2030. Based on the graph, it shows that production decreasing compare to the fuel consumption.

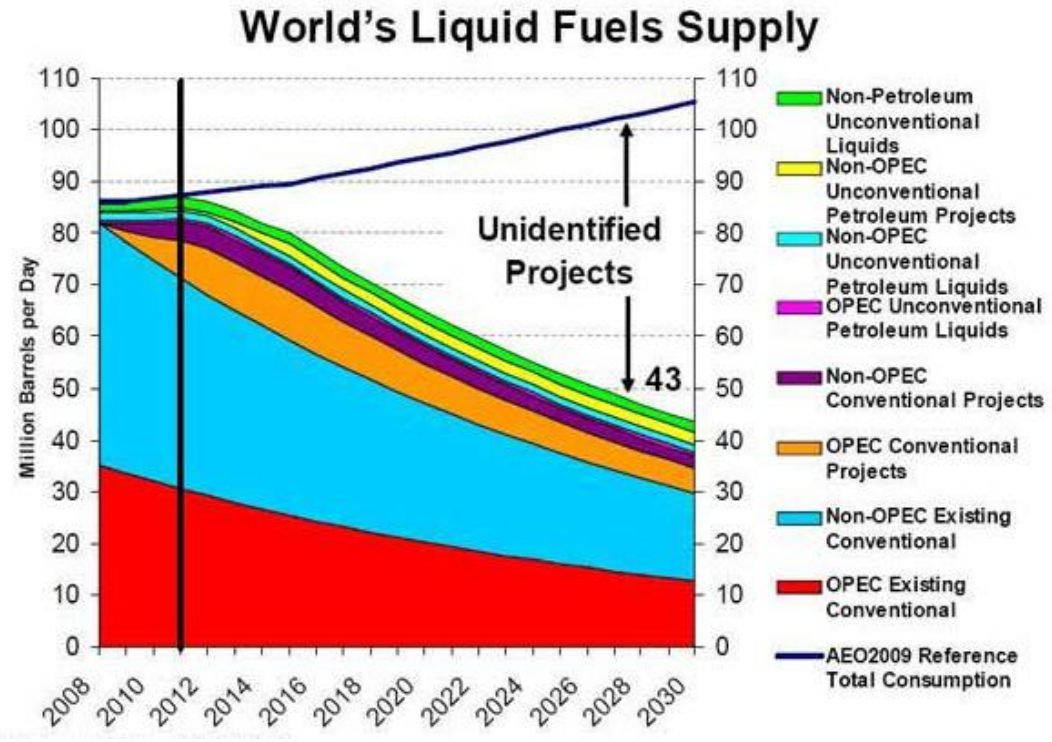

Figure 1.1: World liquid fuel supply graph estimation

That is why research of green technology for transportation which is one of them is fully electrical powered transportation has to be increase and improve. Lately, many research in this sector have been done by engineers and this technology have greatly improved from time to time but the research more focus base on land transportation such electric cars, motor and so on. While for sea transportation, it rarely seen that research for green technology such electrical powered boat were conduct. All sea transportation users still

searching for a potential of green technology to be implement in their transportation before facing this fuel crisis in the future. So to answer this problem, one of the green technology that have great potential in providing an alternative to fuel boat is by implement the solar power system in the boat which use fully electrical power that converted from sunlight. When this green technology improved in the future, it will slowly reduce fuel dependency in transportation sector furthermore it will help us save more money from buying fuel.

1.2 OBJECTIVE OF THE RESEARCH

The objective of this project is to:

i. Develop the charger controller that controls the charging process.

This charger controller will control the charging state of the battery during it discharge that is the voltage below it floating point such as 12V until it fully charge that is during it reach it floating point such that more than 12V, but the floating point is really depend on the type of battery. The circuit will charge the battery when the battery voltage below the floating point and will stop charging when it indicates the battery fully charge or reach it floating point.

ii. Develop a boat that operate using DC motor that powered by solar energy.

This boat will carry the entire device include the PV panel, charger controller, battery and DC motor.

1.3 SCOPE OF THE PROJECT

In this project, there is a several limitation that this project can exceed:

i. The boat is just a prototype of the existent of the solar boat. It will be design in a small scale that around 1.5 meters length x 1 meter width. This boat can only carry two batteries, the charger controller, 1 DC motor and 1 PV panel.
ii. Total load that the boat can carry is around 40 kg maximum.
iii. This project will only use low spec of 12V DC motor which approximately 9 amps current rated and 11 Newton meter power that only suitable for this small scale of boat. The real DC motor for electric boat will have more power, torque and horsepower compare to the DC motor that used in this project.
iv. Operate only during sunny days approximately for 4 hour maximum.
v. The solar charger controller will cover on PWM but will not include Maximum Power Point Tracker (MPPT) mechanism.

1.4 RESEARCH METHODOLOGY

In other for me to get information and knowledge about this project, I need to study further on the charging mechanism, collect more data on the solar radiation pattern and do some revision on how to increase efficiency of the battery charging . There are methodologies that I have referred in order to get knowledge.

1.4.1 Literature review

I have learnt topic about the solar system. The reference that I get is base on the reference book, journal, internet, technical paper from IEEE. All of these references assist me much in understanding the concept and technology.

1.4.2 Understanding the concept and theory

When it comes to theory, the basic charging process is the hardest part in this project. We need to understand it basic process then only we can come out will good and efficient of solar charger controller. To solve this problem, I need to search more information regarding the charging process in other resource. The concept is important for us to understand the operation.

1.4.3 Refer and discuss with supervisor and lecturer

In some information that did not have in book or other reference, I have to refer to with the supervisor and expert lecturer for make the topic clearer.

1.4.4 Simulation

Simulation technique is common method to test electronic circuit before implement it in circuit board. In this project, I have to design circuit using PROTEUS simulation. Troubleshooting need to be done before run this project to ensure all the connection is correct. Some misconnection can make some of the device damage or malfunction.

1.5 THESIS ORGANIZATION

This thesis is organized into 5 chapters. The first chapter of this thesis covers on introduction and overview about this project includes objectives, scopes, and research methodology.

Chapter two is explanation about literature review as study material and references. The topic that I have studied is about the other method of battery charging and improvement that can be made to my project. From the literature review, knowledge can be gained thus implement in this project.

The methodology that I have done will be discussed in chapter 3. This is explanation about the method used to complete hardware and software. Chapter 4 are discussing of the result and analysis of this project and last chapter will describe the conclusion and future recommendations to make this project more reliable and effective.

This thesis also include with references and appendices. We can refer the detail about this project in references. Datasheet of the component, photo and others information also placed on the appendices part.

CHAPTER 2

LITERATURE REVIEW

A review of the literature was performed to identify studies to the topic. The main source for this literature search was the journal form IEEE site and also Science Direct. Other sources include webpage that explain the solar power system. A solar power boat 'Korona' was developed that driven by a three phase asynchronous electrical motor [9]. Interest to note, DC motor will be used in this project that energized from battery that charge by the PV system. The PV systems involve the direct conversion of sunlight into electricity. PV devices are solid state; therefore, they are rugged and simple in design and require very little maintenance [8]. The emergent themes may be dividing into several of board areas: Operation of Photovoltaic solar panel, various methods of charger controller, solar charger controller, Deep cycle battery and then direct current (DC) motor.

2.1 Photovoltaic Solar Panel Operation

Photovoltaic cells in figure 2.1 are made of special materials called semiconductors such as silicon, which is currently used most commonly. Basically, when light strikes the cell, a certain portion of it is absorbed within the semiconductor material. This means that the energy of the absorbed light is

transferred to the semiconductor. The energy knocks electrons loose, allowing them to flow freely. PV cells also all have one or more electric field that acts to force electrons freed by light absorption to flow in a certain direction. This flow of electrons is a current, and by placing metal contacts on the top and bottom of the PV cell, we can draw that current off for external use. A PV cells required p and n type of semiconductor. If the p and n type semiconductor are then brought together and a junction formed so that charge can flow between them. The loose positive and negative carriers are attracted to each other so some of the electrons in the n-type material migrate into the p-type and vice versa. The attraction of unlike charge is counterbalanced by the electric field that is created as the charge of the material is changed when is losses some of its charged particles. This region surrounding the junction is called the depletion region and is what gives the p-n junction the ability to convert light into electricity. The movement of electrons with energy is called an electric current. As long as the sun is shining, the electrical current in a solar-electric system continues [10].

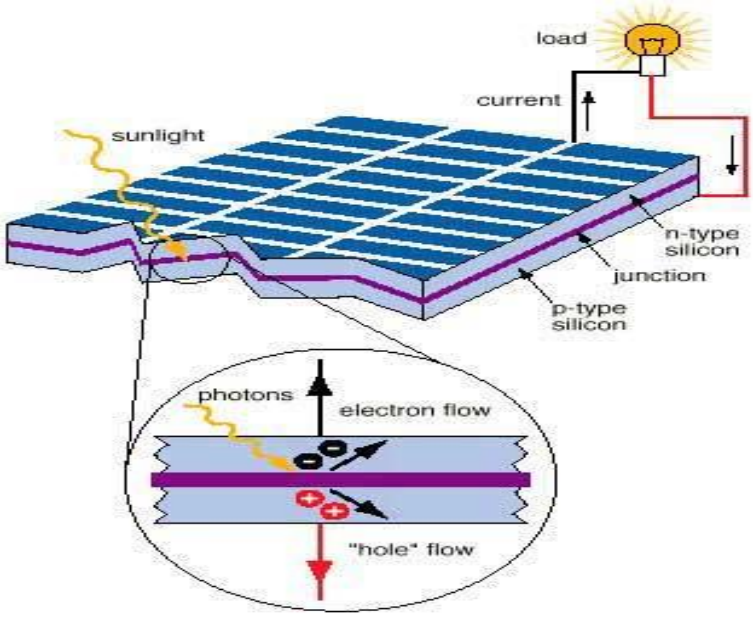

Figure 2.1: Photovoltaic sell operation