UNIVERSITI TEKNIKAL MALAYSIA MELAKA

EVALUATING ELECTRIC BOAT WITH INBOARD ENGINE FOR HOUSEBOAT VESSEL

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A thesis submitted in fulfillment of the requirements for the degree of Bachelor of Mechanical and Manufacturing Engineering Technology with Honours

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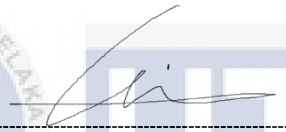
2023

DECLARATION

I declare that this project entitled " Evaluating Electric Boat With Inboard Engine For Houseboat Vessel " 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 : 

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Date : 10/1/2023

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical and Manufacturing Engineering Technology with Honours.

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DEDICATION

I'd like to dedicate my work to my friends and family, especially to my parents whom I deeply respect, Ali Bin Udin and Nor Fareda Binti Abdullah, that gave me lots of support and encouragement. Also, many thanks to my housemate that gave advice for this thesis paper. This thesis is also dedicated to all my lecturers and supervisor which shared their time and knowledge to work on this thesis paper.

ABSTRACT

The electric houseboat has the potential to replace the conventional houseboat that uses non-renewable energy. This is because the houseboat is powered by a renewable energy source that is solar energy. This research aims to design a solar panel system for an electric houseboat vessel by using computer simulation software and to determine the efficiency of solar panel and power consumption of the houseboat electrical appliances. The main type of solar panel will be a monocrystalline panel, because this type of panel has a longer lifespan and higher efficiency than its other counterpart. Also with this panel, by using a rechargeable battery, lithium-ion, it could store excess charges and withstand a more denser power. Before the electricity can be used, a solar inverter is needed to convert the current from direct current (DC) to alternating current (AC). The solar inverter also can be used to boost the current to satisfy the power needed by the houseboat. In order to control the input and output of the current from the battery, a solar controller is needed to avoid the battery from over charging. With this study, the minimum energy required for the houseboat to function can be met. The design of the solar panel system will be compact due to the houseboat has a limited space to work from. With limited space, it is possible to design a small size solar panel. It is said that with smaller solar panel, it is efficient than a larger size panel. Also, a number of lithium-ion battery will be needed in order to satisfy the power needs of the houseboat including with the electrical appliances. A software will be use to design and analyse the solar panel system. The software that will be use is MATLAB.

ABSTRAK

Rumah bot elektrik berpotensi untuk menggantikan bot rumah konvensional yang menggunakan tenaga tidak boleh diperbaharui. Ini kerana bot rumah itu dikuasakan oleh sumber tenaga boleh diperbaharui iaitu tenaga suria. Penyelidikan ini bertujuan untuk mereka bentuk sistem panel solar untuk kapal rumah bot elektrik dengan menggunakan perisian simulasi komputer dan untuk menentukan kecekapan panel solar dan penggunaan kuasa peralatan elektrik rumah bot. Jenis utama panel solar adalah panel monohabluran, kerana panel jenis ini mempunyai jangka hayat yang lebih lama dan kecekapan yang lebih tinggi daripada rakan sejawatannya yang lain. Juga dengan panel ini, dengan menggunakan bateri boleh dicas semula, litium-ion, ia boleh menyimpan lebihan cas dan menahan kuasa yang lebih padat. Sebelum tenaga elektrik boleh digunakan, penyongsang suria diperlukan untuk menukar arus daripada arus terus (DC) kepada arus ulang-alik (AC). Penyongsang solar juga boleh digunakan untuk meningkatkan arus untuk memenuhi kuasa yang diperlukan oleh bot rumah. Untuk mengawal input dan output arus daripada bateri, pengawal solar diperlukan untuk mengelakkan bateri daripada mengecas berlebihan. Dengan kajian ini, tenaga minimum yang diperlukan untuk bot rumah berfungsi dapat dipenuhi. Reka bentuk sistem panel solar akan padat kerana bot rumah mempunyai ruang yang terhad untuk bekerja. Dengan ruang yang terhad, adalah mungkin untuk mereka bentuk panel solar bersaiz kecil. Dikatakan bahawa dengan panel solar yang lebih kecil, ia adalah cekap daripada panel bersaiz lebih besar. Selain itu, beberapa bateri litium-ion akan diperlukan untuk memenuhi keperluan kuasa bot rumah termasuk dengan peralatan elektrik. Perisian akan digunakan untuk mereka bentuk dan menganalisis sistem panel solar. Perisian yang akan digunkan adalah MATLAB.

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In the name of God, the most gracious and merciful, with HIS gracing and blessing has led to success be upon this thesis.

I would like to take this opportunity to express my sincere thanks and appreciation to the following persons and organization that have directly or indirectly given generous contributions towards the success of the academic study.

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LIST OF SYMBOLS AND ABBREVIATIONS

PV	-	Photovoltaic
PVP	-	Photovoltaic Panel
DC	-	Direct Current
AC	-	Alternating Current
mAh	-	Milli Amp Hour
STC	-	Standard Test Conditions
PTC	-	PVUSA Test Conditions
MPPT	-	Maximum Power Point Tracker

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CHAPTER 1

INTRODUCTION

1.1 Background

In this 21st century, electric powered vehicles are considered as a future proof vehicle due to electricity being a sufficient and renewable energy. The basic principle of electric vehicles is a vehicle that used an electric motor rather than using a combustion engine. By using an electric motor, a vehicle would produce a better and efficient torque and power. Also it is stated by Kåberger, T. (2018), on a short-term cost basis, solar power is outcompeting all other sources of electric power among current power plants. Because they do not require any fuel, their marginal cost is zero, whereas electricity generated from fuels always has a marginal cost equal to the fuel used.

Majority of the marine vessels these days are powered by a diesel engine, gasoline engine, or sail power. Other than sail powered, diesel and gasoline are considered as a non renewable source of energy. Diesel and gasoline are categorize as fossil fuel that are created when organic materials, such as plants and animals, decomposed over a period of thousand or million of years. These fuels are found in the Earth's crust which can be burned for energy. Most of the engines these days are using these non-renewable energy to operate.

Due to large consumption of these fossil fuel in these modern times, it is said that the fossil fuels are depleting at an alarming rate. Most marine vehicle manufacturers are considering an hybrid or all electric systems to powered their vessels. It is critical to reduce modern society's reliance on fossil fuels. A rechargeable battery can be used to store

electricity generated by solar energy (Braga, M. H., et al., 2017). With this statement, electricity could replace today's energy source due to electricity is a renewable source.

1.2 Problem Statement

Due to the economy of this country, fuel prices may be unpredictable and it is inconvenience to some people. Especially, to those who depends on combustion engine to power their houseboat vessel. Either to power their electrical equipment or to move the vessel. Fuel consumption are the major concerns of using a combustion engine as a power source. The higher fuel consumption rate, the higher the cost is needed.

Also, due to the depletion of fossil fuel in a few decades time an alternative of renewable source of energy is needed. Most of major vehicle companies are considering on the usage of renewable energy sources as the main source to power their vehicles whether its land, sky, or sea vehicles. The main focused of this thesis is converting a convention houseboat vessel to a fully electric powered houseboat vessel.

Even in modern times, the combustion engines can't really be considered as fully efficient. Also, in a research that has been conducted by Holmberg, K., & Erdemir, A. (2019) stated that the CO^2 emissions of a combustion engines are 4.5 times higher than an electric motor that is used by a electric vehicle.

1.3 Research Objective

The main aim of this research is to evaluate whether an electric houseboat vessel is plausible. These are the objective of this project :

1. To determine the efficiency of solar panel and power consumption of the houseboat electrical appliances.

2. To design a solar panel system for an electric houseboat vessel by using computer simulation software.

1.4 Scope of Research

The scope of this research are as follows:

- To evaluate the efficiency of solar panel by using a software.
- To simulate a solar panel system that is created by using monocrystalline.
- To find the proper battery that could recharged and has a large capacity.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In order to achieve an all electric vessel, a photovoltaic panel (Solar Panel) is needed to convert solar energy into electricity which is used to powered the vessel. Also, a lithium-ion batteries are needed in order to stored excess electric charges that is not in used by the vessel systems.

Figure 2. 1 Solar Panel (BLOOMBERG, 2022)

Figure 2. 2 Lithium-ion Battery (Dragonfly Energy, 2021)

2.2 Solar Energy

Solar energy is the light and heat radiation that comes from the sun. The radiation can be harness either to cause chemical reactions, or generating electricity. Due to advantages such as abundance, pollution-free (also known as green energy), no rotating parts, low maintenance, low noise, low operational costs, and high modularity, solar PV is increasingly becoming the most appropriate source for electricity production among all other sustainable energy sources (Dogga, R., & Pathak, M., 2019).

The overall amount of solar solar radiation incident on Earth much exceeds the number of the world's current and predicted energy needs. This highly distributed source has the ability to meet all future energy demands if properly harnessed. Solar energy, in contrast to the limited fossil fuels coal, petroleum, and natural gas, is predicted to become increasingly popular as a renewable energy source in the 21st century due to its being renewable and non-polluting nature. As stated by Kafka, J. L., & Miller, M. A. (2019), when the world population increases in the coming decades, the International Energy Agency has estimated that global energy demand will increase by an additional 30% between 2016 and 2040, with 40% alone coming from an expected increase in electricity usage.

2.2.1 Photovoltaic Panel (Solar Panel)

Photovoltaic panel (PVP) , or solar panel, is used in the conversion of solar energy into electric energy as shown in Figure 2.1. These PV panel are consist of a special materials that is semiconductors such as silicon. PV works when light strikes the cell, a certain amount of solar energy is then absorbed by the semiconductor material. The absorbed energy is then transferred to the semiconductors. This could cause the electricity to flow by forcing electrical charges to shift in response to an internal electrical field in the cell.

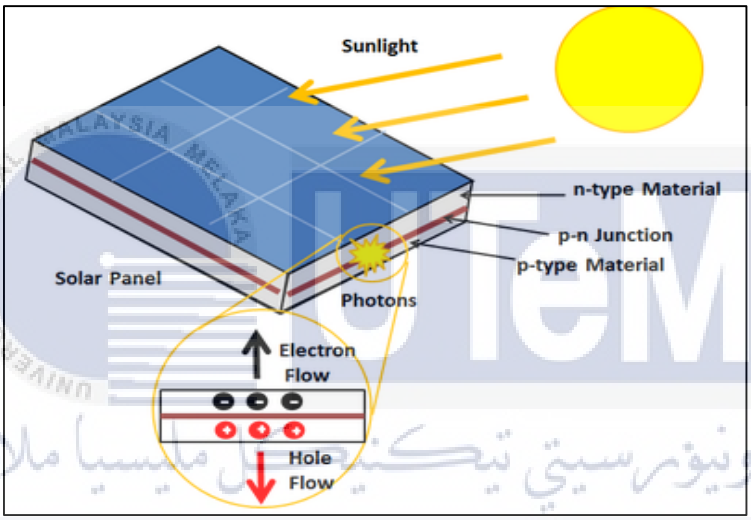

Figure 2. 3 Photovoltaic Cell Operation Diagram (Kota, V. R., et. al., 2017)

2.2.2 Photovoltaic Panel (PVP) Efficiency

With the increasing needs for renewable energy source, by utilizing the solar energy from the sun, it is possible to satisfy the power needs of the future. Also, it is possible to reduce the needs of using non-renewable energy. By this, solar energy efficiency is a critical approach for dealing with electricity shortages. Even with a renewable source, PV panel has some minor drawbacks, such as the build-up of dirt and dust on the surface of the PV panel, which decreases the amount of sunlight that can penetrate and reach the solar cells, lowering the PV panel's efficiency. Also, with proper cleaning the PV is expected to perform better with 15-20% increase in its efficiency (Jaiganesh, K., et al., 2021).

2.3 Solar Inverter

Solar inverter is a device used to convert direct current (DC) to alternating current (AC). The solar inverter also will the boost circuit to increased the voltage. Because the voltage of solar panel modules is often low, inversion as well as voltage boosting are required to match the voltage demand of AC loads. Voltage boosting is based on characteristics such as module voltage, number of modules, and their connection (Dogga, R., & Pathak, M., 2019). Electricity is maintained at a constant voltage in one direction in DC. For AC, the voltage in the circuit changes from positive to negative, electricity flows in both directions.

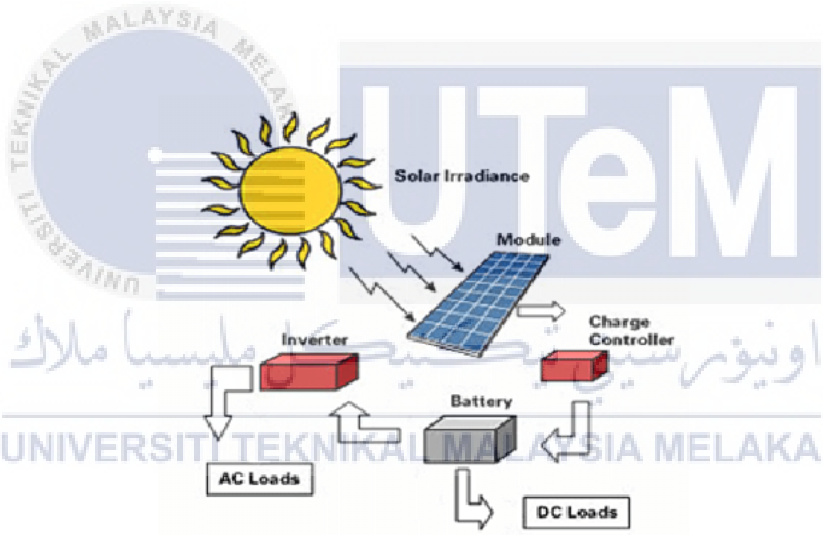

Figure 2. 4 Solar Inverter Illustration (Al-Mamun, A., et. al., 2013)

2.4 Inboard Engine

An inboard motor is a type of boat propulsion system that derived from a four-stroke automotive engine and has been converted for marine. An inboard motor, as opposed to an outboard motor, is an engine located within the midsection of the hull or in front at the stern. The engine drives a propulsion screw at the other end of a driveshaft that runs through the bottom of the hull. But, these days many vessel have two-stroke inboard engines that use oil as a lubricant in addition to the fuel. Two-stroke engines with modern technology are direct-injection engines that burn cleaner than traditional two-stroke engines.

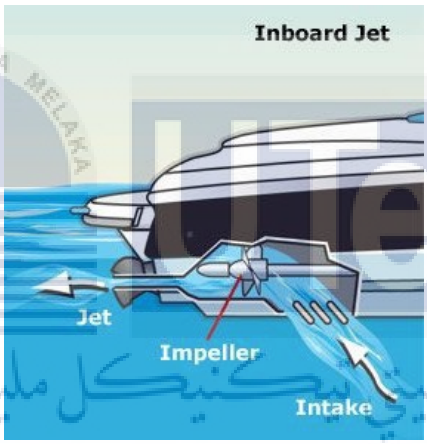

Figure 2. 5 How Inboard Engine Operates (Ghassemi, H., & Forouzan, H., 2016)