DESIGN FOR MANUFACTURING OF PORTABLE POWER SUPPLY HOUSING PROTOTYPE

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This thesis is submitted in accordance with requirement for the Bachelor of Mechanical Engineering (Automotive) (Hons.)

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DECLARATION

"I hereby declare that the work in this thesis is my own except for summaries and quotations which have been duly acknowledged."

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DEDICATION

This thesis is dedicated

for

Dearest Dad and Mom

Ahmad Saidi bin Jamaludin and Nor Fauziah binti Osman

For they are the one who encourage me to finish this project

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Alhamdulillah, thanks to Allah s.w.t, I have run my project of Sarjana Muda for completing my studying at UTeM and I gained invaluable experiences during the project execution.

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ABTRACT

Nowadays the world is moving on too fast in all edge and one of them is the technology. People today really are relying on the electric to support their home appliance all day such as refrigerator, washing machine, television and fan. The improvement in gadget world also makes people need a source of power to support their device. Portable power supply become a necessity to most of the people today but sadly, portable power supply that are in the market nowadays can only support small appliances. So, this is why this project is being conducted. This project is about the design and manufacturing of a new housing for a portable power supply portable. The portable power supply for this project can produce up to 2 kW power. The portable power supply must have a good and attractive design for commercial purpose. In this project, three designs of the housing was produced and one of them will be chosen for its best performance. Selection of material will be made among several options of materials. After the weighted decision matrix was filled with the data, ABS material was chosen between the two materials to be the prototype material.. Then, design two was chosen between the other two designs and the design was going through some modification to make it more attractive. Lastly, the material was confirmed and the prototype of the housing were fabricated. Some analysis of the design was being computed and it shows that the design is safe for the fabrication it is also suitable for its purpose.

ABSTRAK

Pada masa kini, zaman bergerak terlalu pantas dalam semua sudut dan salah satu daripadanya adalah teknologi. Rakyat hari ini benar-benar bergantung kepada peralatan elektrik sebagai perkakas rumah mereka sepanjang hari seperti peti sejuk, mesin basuh, televisyen dan kipas. Kemajuan dalam dunia juga membuat orang memerlukan sumber kuasa untuk menampung peranti mereka. Bekalan kuasa mudah alih benar-benar menjadi sesuatu yang diperlukan oleh kebanyakan orang hari ini tetapi malangnya, bekalan kuasa mudah alih yang berada di pasaran pada masa kini hanya boleh menampung perkakas kecil. Jadi, ini adalah mengapa projek ini dijalankan. Projek ini adalah untuk mereka bentuk dan menghasilkan bekas baru bekalan kuasa mudah alih. Bekalan kuasa mudah alih untuk projek ini boleh menghasilkan sehingga 2 kW kuasa. Bekalan mudah alih ini pelu mempunyai reka bentuk yang baik dan menarik untuk memudah ia mendapatkan tempat di pasaran. Dalam projek ini, tiga reka bentuk bekas akan dihasilkan dan salah satu daripada reka bentuk akan dipilih berdasarkan data-data yang dicari. Pemilihan bahan akan dibuat berdasarkan beberapa pilihan bahan. Selepas matriks keputusan berwajar dipenuhi dengan data, bahan ABS dipilih daripada kedua-dua bahan untuk menjadi bahan prototaip. Kemudian, reka bentuk kedua dipilih daripada dua reka bentuk yang lain dan reka bentuk tadi telah melalui beberapa pengubahsuaian untuk menjadikannya lebih menarik . Akhir sekali, bahan yang telah disahkan dan prototaip perumahan telah siap dibentuk. Beberapa analisis reka bentuk telah dikira dan ia menunjukkan bahawa reka bentuk adalah selamat untuk dibina dan ia juga sesuai untuk tujuannya.

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LIST OF UNITS

Pa	=	Pascal
s	=	seconds
%	=	percent
kg	=	kilogram
RM	=	Ringgit Malaysia
cm	=	centimetre
cm^3	=	centimetre cube
kg/m^2	=	kilogram per meter square
kg/m^3	=	kilogram per meter cube
Amp	=	Ampere
Hz	=	Herz
kHz	=	kilo Herz
ms	=	millisecond

LIST OF ABBREVIATION

UTeM	=	Universiti Teknikal Malaysia Melaka
DC	=	Direct current
AC	=	Alternative current
SMPS	=	Switch Modulus Power Supply
CATIA	=	Computer Aided Three-Dimensional Interactive Application
TNB	=	Tenaga Nasional Berhad
US	=	United Stated
EPA	=	Envinronmental Protection Agency
ABS	=	Acrylonitrile Butadiene Styrene
PLA	=	Polylactic Acid
USB	=	Universal Serial Bus
3D	=	Three dimension
PVC	=	Polyvinyl chloride

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Portable power supply is a device that can produce an amount of power to be used. It is a device which can store some amount of power and can release the power whenever it is needed. The concept of this portable power supply is likely similar to the rechargeable battery, which can absorb and store some amount of power and then release it to be used but the different is that this portable power supply can store and produce even more power compared to the rechargeable battery. Because of the technology becomes even more advanced, the usage of gadget such as smartphone, tablet and play station portable extremely increased. These all things use battery for their power source and the battery needs to be recharged frequently. That is why the request for the portable power supply typically for gadget, lately is becoming a trending but this portable power supply can only support low-power device.

For this portable power supply, it consists of a 12 V 17 Amp direct current (DC) battery. This battery is similar to the car battery which can be charged by the alternator and then supply the power to the car appliances. These mean that this battery can support high power. Then, the portable power supply also consists of switch modulus power supply (SMPS) system with control power transistor to produce 2 kW power with 240 V alternate current (AC). The other components that are installed in the portable power supply are power inverter, solar charging controller, ammeter, voltmeter, USB socket and main socket.

There are so many advantage of this device that can help people to solve their problem. It can help people in their daily life. It can also can be carried anywhere as it is portable and not too big in size. The portable power supply can be used with multipurpose function at one time. This is because the device consist of two sockets and five USB sockets. It can charge many devices at one time and use other appliances at the same time. This portable power supply was designed and developed to solve problems such as power supply shortage, outdoor instance usage and power loss due to flood.

1.2 PROBLEM STATEMENT

Lately, Malaysia had an unstable weather where the weather always changes. In the earlier days, there were always hot day and no rain, now at the end of this year, it is always raining and sometimes there were some strong wind. This situation can bring to electric shortage due to flood of due to the main cable cut-off. During this era, electric is a power source that people really depending on. People will lose their source of light in the night and felt hot because of fan or air-conditioner not functioning.

Next, another problem is at the night market. Many sellers are using generator as their source of power to support their electrical appliances such as light. The generator use fuel as their source of power. It requires extra money when using generator. Not to mention about its noise when the generator is running. It is also big in size and really heavy to carry anywhere.

Nowadays, the portable power supply are being used widely in the world of gadget but in the small size. It can only support small amount of power to supply other device but with the portable power supply build in this way, it can produce few times much bigger power and it is still not available in market yet. This portable power supply needs a really good design to attract people attentions if it is to go to the market. Not only it has to have good and attractive design, the quality of the portable power supply also needed to be great. The customer's voice need to be fulfilled if the portable power supply wants to get a high request.

1.3 OBJECTIVES

The objective of this project is to design the housing for the portable power supply. The second objective is to analyse the different materials for the prototype. The last objective is to fabricate the prototype of the design using the selected material.

1.4 SCOPE

The first scope of the project is to developing three design of portable power supply housing using CATIA software. Next is to choose the best material that will be used for the analysis of the prototype. The next scope is to select the best design based on the data of the material and lastly is to fabricate the prototype of the housing using the selected design and material.

1.5 THESIS OUTLINE

In this thesis, Chapter 1 explained about the introduction of the portable power supply. It also discussed about the problem statement that explains why this project need to be completed. Besides, Chapter 1 also includes the objective and scope for the project. Chapter 2 is about the literature review from the journals and books that are related to the projects and how to design a design. From the journals and the books, the data for the design will be obtained. Next, Chapter 3 is the methodology of the projects. Methodology will be discussed about the requirement that are important for the portable power supply housing. Chapter 4 contain the results and discussions of the design decision. The conclusion of the project and recommendations for future project will be in the last chapter and that is Chapter 5.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

Literature review is the gathering of information from previous research or project. The information can be obtained from referring journal, article or information from reliable websites. The purpose is to help understanding this research more in order to answer the objective of the study.

2.1 THE PORTABLE POWER SUPPLY SYSTEM

Basically, the portable power supply need to received energy or power before it can supply those power to the other appliances. There are some important devices in this basic system of the portable power supply and that is charging system, storage and power inverter. In this project, the charging source is the wall plug source or the solar panel and the storage is the 12 V 17 Amp battery. After the charging source receives the power, it will transfer it to the storage and then, from the battery, it will pass the energy to the power inverter. Here, the direct current will be converted to alternative current. **Figure 2.1** shows the flow of the current. In the power inverter, there will be a high frequency oscillator, transformer, and rectifier, filter and power stage.

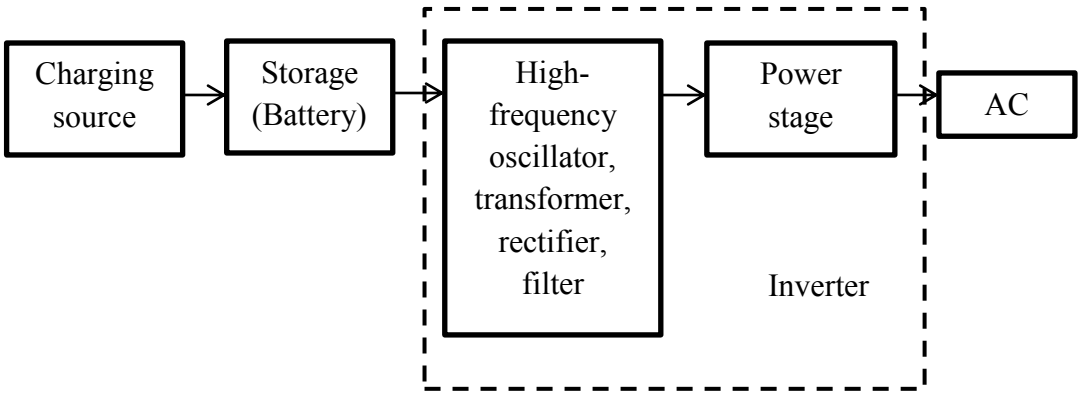

Figure 2.1: The basic system of the portable power supply

The basic systems of the portable power supply not explain detail about the process. So here is the detail process of the device which is explain the cycle of the process. According to **Figure 2.2**, battery will accept power from two sources and that is from the 240 V wall plug source and from the solar panel.

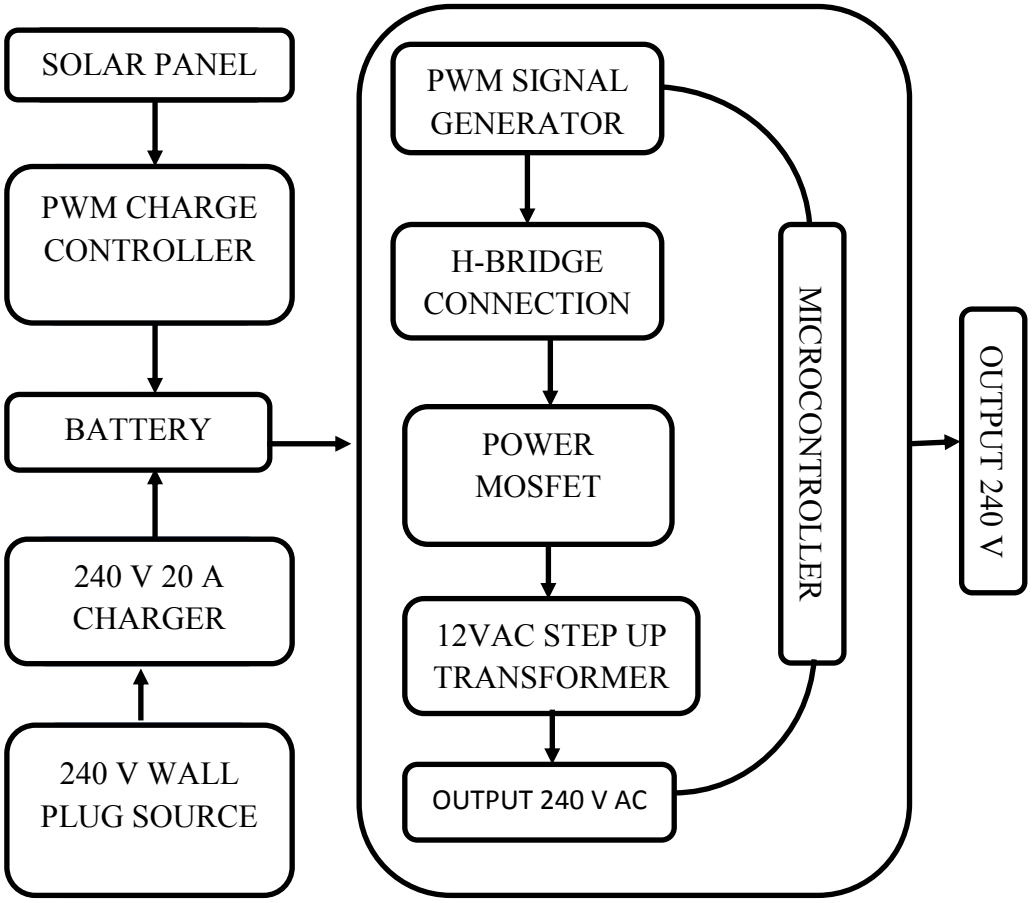

Figure 2.2: The overall process of the portable power supply

Before it arrives at the battery, it pass through 240 V 20 Amp charger and PWM solar controller for the power from the solar panel. Next, from the battery it will pass to the power inverter. The process in the power inverter works in cycle. **Figure 2.3** shows the cycle in the graph of voltage against time. As can be seen, the red waveform is a pure sine wave, blue is a modified sine wave, and green is a square wave. The specified period (20 ms) would vary based on desired frequency. First, the microcontroller will receive the signal and pass to the PWM signal generator. Then it will pass through the H-bridge connection and power mosfet and arrived at the step up transformer. The transformer is the last component and 240 V AC is produce. The 240 V A.C that is produced is not the same as 240 V AC that is supplied from the wall plug that T.N.B provided. This is because the A.C that is produced is Modified Sine Wave which is varying from the Pure Sine Wave from the wall outlet socket.

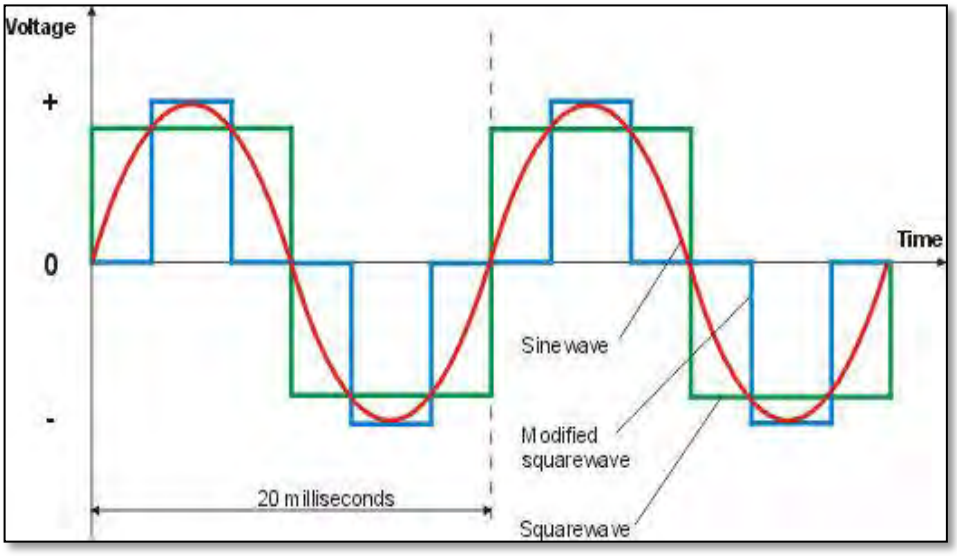

Figure 2.3: Graph of voltage against time (Stackexchange.com)

2.2 DESIGN PROCESS

Design can have many different definitions. Most generally, “design” is a process for deliberately creating a product to meet a set of needs. Mobile applications development requires both engineering design and product design. Engineering design focuses on physics, such as speed, mass and other performance measures while product design also considers user and consumers by asking what the user wants in a product.

To have a great design, it needs to have creativity. Creativity requires large amounts of ideas, flexibility of ideas and originality. It is important not to focus on practicality only when generating ideas. Doing so would impede the flow of ideas and impractical ideas often point toward a more practical options. Common problems that occur when brainstorming include using the first idea that pops up, inadequate competitive review, not involving entire team in process and missing potentially strong solutions.

2.2.1 History and evolution of design goal

Historically, a variety of factors, both internal and external to a company, have influenced its product design goals. For instance, the mass production paradigm pioneered by Henry Ford resulted in concepts of building products in assembly lines, use of interchangeable parts, and standardization of parts and components with a view towards reducing product cost (Bralla, 1996). Customers demand for quality products prompted manufacturing companies to consider quality as their key product design goal (Taguchi et al., 1989). The establishment of the US Consumer Product Safety Commission in 1972 prompted manufacturers to project product safety as their key design goal (Mital and Anand, 1992). The advent of the computer screen and the resulting digital interface may be considered the primary reason for companies projecting product usability as their prime product design goal (Nielsen, 1993). Similarly, the need for product manufacturers to reduce assembly time and cost have prompted product designs built from design for assembly processes (Miyakawa and Ohashi, 1986).

Recent legislation from the US Environmental Protection Agency (EPA) has prompted companies to project Design for Environmental Friendliness or Green Design as an important product design goal (Billatos and Nevrekar, 1994). Ford Motor Company recently set up a facility for disassembling used cars and selling used parts, profitability of which will depend upon designing products for disassembly (Wall Street Journal, 1999). Simultaneous optimization of a number of design goals (Design for ``X'') where X could stand for assembly, manufacturability, safety, reliability or any of the other design goals, is the latest in the research agenda (Ullman, 1997). While all these different design goals have gained recognition and acceptance, product performance or what is broadly known as product functionality, as a design goal, has often been taken for granted by designers. Indeed, the provision of functionality in a product is the purpose of design. It is possible that even though product functionality may have been an important initial product design goal for designers, the necessity to accord other design goals like safety, usability and quality to a higher priority may have relegated the task of ensuring functionality in the prototype to a relatively lower priority.

2.2.2 Ways to innovate

There are three main sources of innovation and that is technology, market and users. Though in reality, all products are a combination of more than one source. Technology is where innovation can be achieved through a new form of technology, either by creating or utilizing it. Inventing a new technology can be slow due to the nature of research and development and is often a risky process financially. It needs to takes in what are the special of the design between the other designs. Market innovations come from changes in the market. These changes can be changes in demographic trends, such as aging baby boomers, or changes in competitors. Market inspired product designs are often based on existing product concepts. Lastly is users. Product needs can be found by observing an individual. It does not necessarily assume a preexisting concept. While observation process can require only a few participants, the result may not be representative.

2.2.3 Design phases

The four main phases of the design process are shown in **Figure 2.4** below.

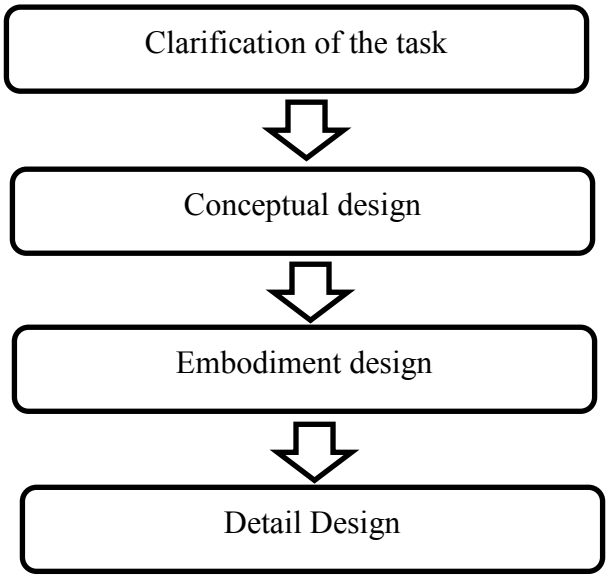

Figure 2.4: The main phases of the design process (Glegg, 1969)

Clarification of the task is the starting point for the design process which is an idea or a market need, often stated in vague (Pahl and Springer, 1996). Before subsequent design phases start, it is important to clarify the task by identifying the true requirement and constraints. The result of this phase is a design specification which is a key working document that should be continually reviewed and updated as the design develops. Then, the real need is need to identify. Identify real need is to avoid solving the wrong problem which is wise to spend some time identifying the true needs and preparing a clear solution. This can avoids any indication of how the problem should be solved. A useful technique is to systematically raise the level of abstraction.

Next is the conceptual design. In this phases, concepts with the potential of fulfilling the requirements listed in the design specification must be generated (Pahl and Springer, 1996). The overall functional and physical relationships must be considered and combined with preliminary embodiment features. The result of this phase is concept drawing. The first step in conceptual design is to identify the overall function (Glegg, 1972). The overall functions follow directly from the solution neutral problem statement.