DESIGN AND DEVELOPMENT OF AN AUTOMATIC PORTABLE GREEN TIRE INFLATOR

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DECLARATION

I declare that this thesis entitled "DESIGN AND DEVELOPMENT OF AN AUTOMATIC PORTABLE GREEN TIRE INFLATOR is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have checked this report entitled “Design and Development of an Automatic Portable Green Tire Inflator” and in my opinion, this project report it complies the partial fulfillment for awarding the award of the degree of Bachelor of Electrical Engineering with Honours

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Supervisor Name : DR. KYAIRUL AZMI BIN BAHARIN

Date : 5 JULAI 2021

DEDICATIONS

To my beloved beloved parents, Nagahiah A/L Arumugam and Usha Rani A/P Munusamy.

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ABSTRACT

An electricity or alternating current produced which are commonly used were considered as an expensive alternative for a long run. The price of the electricity bill varies according to the amount of energy used. The use of AC air compressor pumps consumes considerable amount of energy even when its not in use, which results in waste of energy. Therefore, to overcome energy waste, an application where electrical energy produced by a solar panel will be directed in to a circuit called solar charge controlling circuit. This circuit will help to store the energy generated by the solar panel in the battery. The energy stored in the battery is used to turn on the tire inflator which needs a constant 12 VDC to operate. The main objective of this project is to design, analyse, develop, and test the automatic portable green tire inflator. Moreover, the design should be portable and easy to move around when needed to power up tire inflator. The main scopes of this project is to use solar panel to energize the battery and develop a solar charge controller circuit which will regulate the charging and discharging of the battery. Besides that, a microcontroller was included into this design in order to control the system to be smart and efficient which will also help to protect the battery. Moreover, this portable green tire inflator will be designed to be easily moved around and most importantly, it is totally depends on renewable energy which is gained from sunlight through solar panel. This portable green tire inflator is also expected to provide an alternative 12 VDC source with a help of an adapter during emergency. Moreover, from the environmental impact perspective, there is no harm done by the power generation which totally depends on the solar panel. The material used to design the outer layer of this project must be strong enough to withstand the weight of the battery. Thus, a strong base is needed so that this entire design is stable and not fragile while it being moved around.

ABSTRAK

Arus elektrik atau arus bolak yang dihasilkan kerap dianggap sebagai alternatif yang mahal untuk jangka masa yang panjang. Harga bil elektrik berbeza mengikut jumlah tenaga yang digunakan. Penggunaan pam pemampat udara AC kekal mengunakan tenaga walaupun berada dalam keadaan bersiap sedia, yang mengakibatkan kehilangan atau pembaziran tenaga. Oleh itu, untuk mengatasi pembaziran tenaga, aplikasi dari tenaga elektrik yang dihasilkan oleh panel solar akan diarahkan ke litar pengawal cas solar. Litar ini akan membantu menyimpan tenaga yang dihasilkan oleh panel solar di dalam bateri. Tenaga yang tersimpan di dalam bateri akan digunakan untuk menghidupkan pam tayar yang memerlukan 12 VDC untuk beroperasi. Objektif utama projek ini adalah merancang, menganalisis, membangun, dan menguji pam tayar automatik yang mampu menghasilkan 12 VDC. Lebih-lebih lagi, reka bentuknya mestilah mudah untuk dipindahkan apabila diperlukan untuk menghidupkan pam tayar tersebut. Skop utama projek ini adalah untuk menggunakan panel solar untuk memberi mengecas bateri dan reka bentuk litar pengawal cas solar yang akan mengatur pengisian dan pengosongan bateri. Selain itu, mikrokontroler dimasukkan ke dalam reka bentuk ini untuk mengawal sistem berfungsi dengan pintar dan efisien yang juga akan membantu melindungi bateri yang digunakan. Lebih-lebih lagi, pam tayar automatik ini akan dirancang untuk digerakan dengan mudah dan yang paling penting, ia bergantung sepenuhnya kepada tenaga boleh diperbaharui yang dihasilkan oleh panel solar. Inflator pam tayar auutomatik ini juga dapat menyediakan sumber 12 VDC alternatif dengan bantuan penyesuai semasa kecemasan. Lebih-lebih lagi, dari perspektif kesan persekitaran, tidak ada bahaya kepada alam sekitar kerana penggunaan solar untuk menjana elektrik yang hanya menggunakan tenaga cahaya untuk ditukarkan menjadi tenaga elektrik. Bahan yang digunakan untuk merancang lapisan luar projek ini mestilah cukup kuat untuk menahan berat bateri. Oleh itu, asas yang kuat diperlukan agar keseluruhan reka bentuk ini stabil semasa dipindahkan.

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LIST OF SYMBOLS AND ABBREVIATIONS

AC	- Alternating Current
DC	-Direct Current
TVS	-Transient Voltage Suppression
MOSFET	-Metal-Oxide-Semiconductor-Field Effect -Transistor
VDC	-Voltage-Direct Current
Amp	-Ampere
P	-Power
W	-Watt
PV	-Photo-voltaic
FYP 1	-Final Year Project 1
FYP 2	-Final Year Project 2
IDE	-Intergrated Developement Enviroment
LCD	-Liquid Crystal Display
LED	-Light Emitting Diode
I2C	-Inter-integrated Circuit
R	-Resistor
T	-Transistor
uf	-Micro Farad
SDA	-Serial Data Wire
SCL	-Serial Clock Wire

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Overview

This chapter particularly explains the overall introduction regarding the project background and the also problem statement. In view of this project, brief explanation on the observation on solar panels which produces electricity that will be channeled to charge up a battery has been described. The main purpose of the electricity generated will be to power on the tire inflator which needs 12VDC to start. Moreover, objectives and scope of this project are also discussed in this chapter.

1.2 Project Background

Generation of power from power plants really needs high maintenance and a lot of man power to keep it running without any problem. Moreover, the use of fossil fuels which are categorized as a non-renewable energy draws a concern towards sustainability of power in future where electricity is always increasing in demand. In order to solve this problem, the focus should be direct towards renewable energy power generation. This is because power generation using renewable energy brings a lot of positive impact towards the society and environment. First of all, it is a clean energy which is less harm full then generation of power using a fossil fuel. Besides that, for a long run, the generation using a renewable energy is considered as sustainable and cheaper. Electricity is a form of energy which is considered extremely important to mankind. Use of electricity is increasing day by day. The electricity finds its application in all the domains. Converting solar energy into electrical energy is one of the best ways to reduce fossil fuel consumption. In today's world, electricity becomes much more important than those days because new technologies and gadgets are growing extremely fast and completely depends on electricity. However, there are two types of electricity produced which are called as Alternating Current and Direct Current. The main difference or advantage of the Dc current compared to Ac is that

the extra energy produced can be stored when not in use. Therefore, there will be no energy losses and furthermore it can reduce the overall cost of bill depending on the usage. Another important factor that plays a major role in electricity generation is whether the energy produced is a renewable energy or non-renewable energy. This is a considered as an important factor because renewable energy brings less to zero harm towards the environment and categorized as a clean energy.

1.3 Motivation

Air compressor is an essential equipment in a workshop. Mostly each and every workshop will be equipped with an AC type air compressor which uses the AC current to operate. One of the main functions of this air compressors in a workshop is to inflate tires. However, there are few limitations that need to be considered when it comes to operation factors. The first one is the usage of an AC compressor to inflate tire does increase the electricity bill for a long run. This is due to the automatic air compressing feature which will operate in order to maintain the desired pressure even when it's completely not in use. The second important factor is that the AC air compressor cannot be used at all places which does not provide AC supply. Next, it's important to note that Ac air compressor can't be used when blackout or electricity disruption occurs. In addition to that, due to this pandemic, economy of a lot of countries are affected and this really does impact the industrial sectors. Therefore, it can be said that managements are trying their level best to minimize their overall cost in order to compensate the situation. In addition to that, global market for portable air compressor is expected to increase by 4% in the year of 2024 according to Global Market Insights research analysis as shown in figure 1-1 [1]

Figure 1-1: Global statistics on portable air compressor market [1]

1.4 Problem Statement

This design and development of this project is aimed to overcome few problems. It includes problems which are faced by each and every sector that are heavily depends on an AC pump compressor, particularly in a car workshop. One of the major problems is the difficulty to get electrical energy during emergency or when needed. Besides that, from the form of effect to the environment, the usage of green energy like solar panel which is being used in this portable green tire inflator does not give any negative impact to the environment. Things or the frame used to build this project should be strong enough to support the weight of the battery where the knowledge and information are gathered based on the literature review that had been done. This is because a steel or the frame which is strong enough will be needed to support the entire project's weight and also keeping in mind to avoid any short circuit between the battery, circuit and also the solar panel. This is mainly because when a project is not stable and constantly being moved then there will be a lot of problems arise due to contact issues. Therefore, a strong frame is needed to support the entire project.

1.5 Objectives

The purposes of this project are:

1. Design a prototype of an automatic portable green tire inflator.

2. Develop and analyze the operation of the 12VDC green tire inflator.

3. Test the performance to meet the desired outcome.

1.6 Scope

This project mainly focuses on:

1. Using a solar panel which produces a maximum output voltage of 18 Volt, power maximum of 5W and output current of 0.28Amp.

2. Developing a solar charge circuit controller which will be able to regulated the charge from the solar to the battery and also manages the load at the same time.

3. Involvement of a micro controller “Arduino Nano” to make the solar charge controller much more efficient and smarter by displaying the necessary parameters on the display.

4. Storage of charge in a sealed lead acid battery with the capacity of 12 VDC.

1.7 Project Outline

This project contains five chapters:

Chapter 1 discusses more on the background, problem statement, objectives, and scope of this study. In other words, it provides an overview of the study.

Chapter 2 explains the literature reviews about the solar power, solar charge controller, battery, microcontroller and also Dc tire inflator.

Chapter 3 covers all details on methods that were used to complete this project.

Chapter 4 will present the results to compensate the choice of components in chapter 3 and schematic diagram of the circuit.

Chapter 5 gives the conclusion of the overall report of this project and improvement or recommendations that can be add on in future.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

A literature review is a body of text that aims to review the critical points of current knowledge and or methodological approaches on a particular topic. Literature reviews are secondary sources, and as such, do not report any new or original experimental work. Most often associated with academic-oriented literature, such as theses, a literature review usually precedes a research proposal and results section. Therefore, this topic basically contents all the journal, articles and information related to this portable green tire inflator project. Therefore, a very basic insight on the solar panel, charge controller circuit, battery, Arduino Nano, battery and Dc tire inflator had been done in the following sub-chapters.

2.2 Essential Components.

2.2.1 Solar Panel

A solar panel is a word which is closely related to photo-voltaic (PV module). A solar panel module needs light energy from the sun to generate electricity through a process called photo voltaic effect [2]. Figure 2-1 below shows how a solar panel converts the sunlight into electrical energy [3].

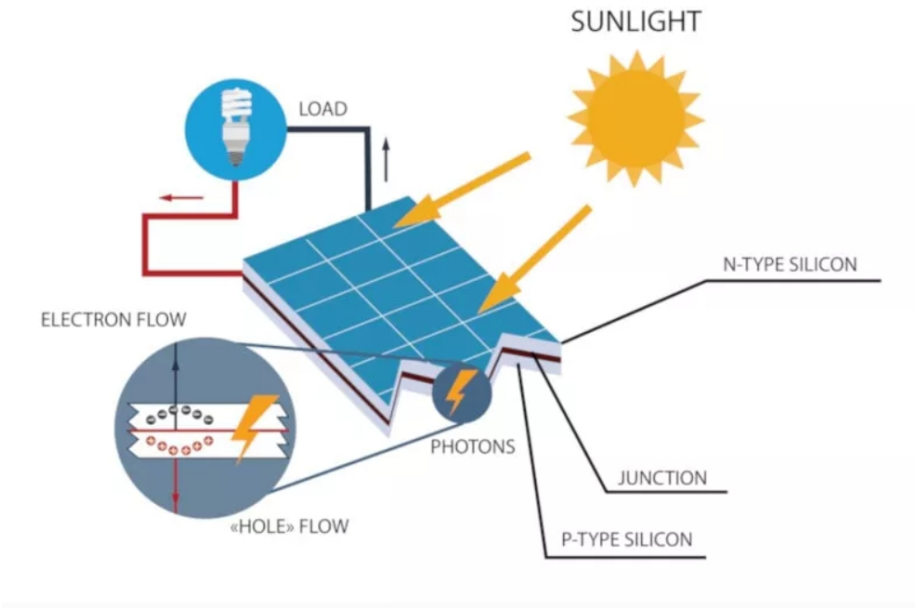

Figure 2-1: The cross sectional of a solar panel and how it converts sunlight into electrical energy [3]

It is a form of photoelectric cell, defined as a device whose electrical characteristics, such as current, voltage, or resistance, vary when exposed to light [4]. One of the key solutions towards fulfilling the ever growing worldwide demand for energy is to develop the solar power technologies because earth receives an unimaginable amount of solar energy. Sun provides enough energy in one minute to supply the world's energy needs for one year [4]. As that being said, theoretically solar energy has the maximum potential to adequately fulfil the electricity demand of the entire planet if there is a technology which can optimize the harvesting and supplying of solar energy were readily available by using a solar panel[5]. Besides that, another important advantages with regard to solar panel usage is closely related towards reducing the overall global carbon emissions, which is considered as a massive global environmental , social and also economics issues in recent years[5]. Moreover solar energy is free and it has the highest availability if compared to other non-renewable sources. Next is solar panel that harvest energy from the solar energy is clean and absolutely free of emissions, where it does not produce any pollutants or by product towards the environment[6]. That being said, to design a prototype structure that generates and holds a relatively small amount of power, polycrystalline type of solar panel is

selected to generate electricity among few other types of solar panels that are widely being used[7]. This specific type of panel was picked because of its advantages and suitability to this design. Polycrystalline solar panels are cheaper compared to Monocrystalline but in terms of efficiency its not far behind from Monocrystalline panels[7]. However, there are few types of solar panels in the market depending on the application it is being used. Table 2-1 below summarizes the most important differences between the three types of solar panels which are widely used [8] :

Table 2-1: Widely used types of solar panel and the differences [8]

Type / Factors	Monocrystalline Modules	Polycrystalline Modules	Thin Layer Modules
Efficiency Rate	16-20%	14-18%	6-14%
Low Light Behaviour	Losses under diffuse lightning	Losses under diffuse lightning	Only low losses
Thermal Behaviour	Losses at high temperature	Losses at high temperature	Only low losses
Costs	More expensive than polycrystalline & thin layer modules	Cheaper than Monocrystalline modules	Cheaper than Monocrystalline & polycrystalline modules
Long Term Test	Very high performance, stable, high durability	High performance, stable, high durability	Average performance, shorter durability
Weight per m^2	Higher	Higher	Lower
Susceptibility of Failure	Very Low	Very Low	Low