
# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

# DESIGN AND DEVELOPMENT OF PORTABLE SOLAR TRAINING KIT FOR TEACHING AND LEARNING PURPOSE

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Engineering Technology (Power Industry) with Honours.

by

**MUHAMMAD FERDAUS BIN ZULKILFI**

**B071510697**

**940621016823**

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING TECHNOLOGY

2019

# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Tajuk: design and development of portable solar training kit for teaching and learning purpose

Sesi Pengajian: 2019

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**APPROVAL**

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Power Industry) with Honours. The member of the supervisory is as follow:

Signature: …….

Supervisor : EMY ZAIRAH BINTI AHMAD

Signature: …….

Co-supervisor: CO SUPERVISOR NAME (delete if NA)

# ABSTRAK

Tujuan utama projek ini adalah untuk membangun kit latihan solar mudah alih untuk tujuan pengajaran dan pembelajaran. Kit latihan biasa biasanya direka dalam saiz yang lebih besar yang tidak sesuai untuk tujuan pembelajaran luar. Dengan ciptaan ini, kit latihan mudah alih yang mudah dibawa dan digunakan akan mengatasi masalah ini. Panel solar yang pelbagai jenis dan tripod boleh laras turut disediakan bagi tujuan pembelajaran. Voltan keluaran daripada litar akan terbahagi kepada dua iaitu 12Vdc/7.2A dan 220Vac/ serta tidak memerlukan perisian kerana terjana dangan perkakasan sepenuhnya dan melalui beberapa fasa. Menggunakan analisis data yang digambil dari sistem, keberkesanan dan prestasi produk akan dinilai dan akan dipelihara untuk penambahbaikan.

## ABSTRACT

The main purpose of the project is to build mobile solar training kits for teaching and learning purposes. Regular training kits are usually designed in larger sizes that are not suitable for outdoor learning purposes. With this invention, the portable and portable exercise kit that easy to carry and use will solve this problem. Numerous types of solar panels and adjustable tripods are also offered for learning purposes. The output voltage of the circuit will be divided into two, namely 12Vdc / 7.2A and 220Vac, and does not require software as it is fully developed by hardware and through several phases. Using the analyse data retrieve from the system, the effectiveness and the performance of the product will then evaluate and kept for further improvement.

## DEDICATION

I dedicated this project to all humble beings who have aided me in any way to complete this project. Whose scarifies seeded my success, especially my beloved parents who always support me during completing this project. i deem them as a divine source of inspiration.

**ACKNOWLEDGEMENTS**

First of all I was thankful to Almighty Allah, I would like to extend my deepest gratitude to my supervisor, Puan Emy Zairah Binti Ahmad for her valuable comment and patience. Without her support I would have never been succeeded in achieving this project. She has not only given feedback but also motivated me for work.

I would also like to thanks to our friends who supported and stood beside me throughout this project.

Lastly, I would like to praise our parents and family members, with whom this project came into reality. I dedicate this project to our respective families.

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# CHAPTER 1

# INTRODUCTION

## 1.0 Introduction

In this chapter, the brief introduction about our project will be given. It will contain the background, objective, problems statement and the scope of this project

## 1.1 Project Background

Malaysia has a lot of renewable energy sources that can be develop like solar, wind, biomass, hydro, geothermal and tidal waves. However, it has not expanded extensively. Solar energy has been classified as one of the most viable and most broadly used as a renewable energy system in our state due to the weather aspect and daylight capability via the daylight. Consequently, knowledge of solar energy is necessary for young generations as they will use this system not only in the future but also present[1]. Before jumping to more advanced knowledge, they should have a solid basic knowledge of this solar energy systems. Through the existing educational system, students are more focused on the indoor educational system which is more to theory and because of that there are a few of students who feel bored and can't focus on learning and teaching sessions[2].

**Figure 1. 1 Solar Photovoltaic Training Kit**

The learning process should be something interesting and hoped for by every student. Outdoor learning systems should be an alternative to these needs because the free and more open atmosphere will provide comfort and ability to attract students moreover to learn something new like renewable energy systems and the cause of this, portable training kit for the outdoor teaching and learning purpose are essential[3].

This portable training kit will have 2 main parts, which is solar panel section and the control section. On the solar panels section there will be a tripod that can adjust the angle of the solar and its height. The solar panel also can be plugged in and unplug because this training kit has various types of solar panels. Next, in the control section, will be divided into three parts which is the solar charger controller that will ensure the solar panel that been used will charge the battery. After that, the output from the battery will pass through the second phase of the inverter which will convert dc voltage to ac voltage. In this phase also, the voltage will be increased from 12vdc/7.2A to 220vac. The next phase is a divider to the output terminal where the kit will have 2 outputs of 12vdc/7.2A and 220vac which can be connected to an existing output load or external load.

## 1.2 Problem Statement

Nowadays, the solar education system is more too theoretical knowledge and because of that, there are a handful of students who are easily uninterested and not capable to give an attention. Additionally, current training kits are also located in the laboratory because of their large size and few students can't imagine the conditions and ways of using them in the real world. Outdoor training is better because students are able to know and learn factors that will affect the efficiency of a solar panel.

## 1.3 Objectives

The objectives of this project are:

(i) To design the portable solar training kit for teaching and learning purpose.

(ii) To develop the portable solar training kit that can adjust the angle and height

(iii) To evaluate and analyse the performance of the developed system in term of light intensity, angle, height and shading.

## 1.4 Scopes of Project

The scopes of this project are:

(i) The design of the portable solar training kit that easy to use and carry for outdoor learning purpose.

(ii) The system design are divided into two part which various panel solar that can be plugin to the adjustable tripod stand and the control section which able to convert dc output voltage to ac output voltage.

(iii) To test the functionality of the system design.

# CHAPTER 2

# LITERATURE REVIEW

## 2.0 Introduction

This chapter, provides a detailed review, discussion and comment on published work. There are many sources may been taken such as journal, website, original report, book, trusted article and review of research. This chapter also discuss more detailed about project and previous project that had been done to make some modification to upgrade or to take some idea for this project.

## 2.1 Previous Project Related Project

This chapter, provides a detailed review, discussion and comment on published work. There are many sources may been taken such as journal, website, original report, book, trusted article and review of research. This chapter also discuss more detailed about project and previous project that had been done to make some modification to upgrade or to take some idea for this project.

### 2.1.1 Solar Trainer for Laboratory Photovoltaic Systems Education

The project is presented by way of (Dolan, Friedman, Huff, and Taufik, 2012) are develop a photovoltaic trainer kit to be used as a photovoltaic instrument in a laboratory environment. The goal of this mission is to permits pretty a number balance of system aspects to be investigated and the have an impact on of environmental stipulations when producing power with solar photovoltaic panels to be studied. This project combine a

mechanical part like gear and steel frame with electrical part like charger controller and other components. The examined include tilt of the panel, light intensity, and temperature. The trainer also consists of the potential to check the effect of different kinds of solar panels, charge controllers, size of inverters, and types of battery. These variables are easily measured and displayed conveniently on an LCD screen mounted to the control panel. The limitation of this project is the size. Although the entire design is contained within a self-powered and portable rolling cart but since the size is too big, they are not suitable to be called as portable training kit for outdoor activity.

### 2.1.2 Development of Solar Educational Training Kit

According to the project that conducted by (Ranjit, Anas, Subramaniam, Tan, Chuah, 2012) they'd proposed a model of a real time grid assisted from low power direct current to high power alternating current as a solar educational training kit for an early education process to regarding the property of energy conversion method. Integrating the switching concept, grid connection can solely be switched on if the stored energy in the battery is insufficient to energize or supply the training kit. Programmable Integrated Circuit (PIC) is integrated into the educational training kit to change it to display and indicates the battery voltage level because in conjointly participate in switching between the battery and grid. In the nutshell, an easy and user friendly measurement training kit is deliberately designed for user's handwork purposes. The limitation to this project is it can't be use as portable solar training kit that able to measure the several things that effect solar efficiency.

### 2.1.3 Renewable Energies Educational Kit

As stated by (Franz Trieb and Konrad Blum, 1994), this project focus on development of easily transportable renewable energy education kits for the training especially in non-urban counties. This project also supports the creation of narrow education centres and also the info of target groups like potential customers, teachers and local decision makers. The kits can carries with it experimental equipment for education and demonstration, audio-visual teaching material, databases on bibliography and contacts, advises for local planning, and the essential equipment for calling a global data network by means of an electronic, energy self-sufficient data processing and communication system. The modules will be extremely compact, portable and instructive and organise a fully independent stand-alone educational unit. The kits might be used as root for correspondence courses supported by television in the context of local renewable energy/ environmental education programs. The project will understand the development of standard modules with precise levels and educational aims on normal use of energy, solar thermal applications, helioelectrical and photovoltaic systems, wind and hydropower, renewable fuels and biomass conversion, and geothermal and ocean energy. The kits also can be used by narrow projects in the frame of worldwide development activities and for academia and other technical education. The limitation for this project is its function which is too open to all renewable energy and not just focus on solar energy so this will makes it only take into the conjoint things of solar energy education.

### 2.1.4 Study of Renewable Energy Potential in Malaysia

Based on the study that proposed by (Azman, Rahman, Bakar, Hanaf,,Khamis, 2011), the target of this study is to see the foremost appropriate renewable energy generation to be enforced in Malaysia from four obvious choices out there that area unit solar, wind, biomass and tidal wave. A study has been administrated in quite a few contributory factors specifically geographical distribution, technology tangled and economic investigation. The analysis has been performed by gathering the associated data and statistics from preceding studies as properly as and visits to internet sites and associated authorities. The results of these analysis indicates that biomass electricity era has the foremost encouraging doable to be developed in Malaysia as shown by method of evidences from the comparative study being created during this paper. The limitation due to this study, it's not a specification study of the solar energy education because it's about the type of the potential renewable energy.

### 2.1.5 Factors Affecting Solar Photovoltaic Power Output

By referring the study that proposed by (Nakkela,2016), this paper focus on the utilization of solar energy to produce electrical energy, for this sun-earth angular relation was found using declination angle of earth based on day number, azimuth angle, altitude angle, angle of incidence for particular location. The aim of this study will be achieved by gathering a data of radiation for the consider site and calculating real radiation on tilt surface by applying correction to the data collected. Besides that, a simulation of solar photovoltaic panel will be run by using five parameter model of cell considering top Indian solar panel manufacturing and calculate approximately the output power by using temperature, wind, radiation, and location as input. Identical output of simulation with on-line simulators, the next part of this paper is estimation of installation cost of solar

power plant, cost of generations, LCOE, performance ratio, return of investment, capacity utilization factor, comparing to the conventional rates. The limitation of this study was too focus on mathematical calculation which are not suitable for the outdoor learning activity which are supposed to be more practically.

## 2.2 Solar Panel

The Earth takes supply of an out of this world supply of solar energy. The sun, an unpleasant star, may perhaps be a nuclear reactor that has been boiling hot over four billion centuries. It provides enough energy in one minute to produce the world's energy wants for one year. In one day, it provides a lot of energy than our current population would consume in a few years. In fact, the number of radiation putting the planet over a three-day amount is appreciating the energy keep all told fossil energy sources.[4] Alternative energy could be a free, inexhaustible resource, however harnessing it's a comparatively new plan. Considering that the primary sensible star cells were created but thirty years past, that the prolongation of star skilled corporations coming up with a singular associate degreed specific solar energy system for homes usage means that there's now not an excuse to not think about solar energy for home usage.

The largest jumps in effectively came with the creation of the transistor and accompanying semiconductor technology. There are a number of benefits of photovoltaic solar electricity that make it one of the most promising renewable power sources in the world. It is non-polluting, has no shifting parts that ought to ruin down, requires little upkeep and no supervision, and has a long-life time with low walking fees. It is exclusively unique because no large-scale installation is essential [5]. Isolated areas can easily produce their own source of electricity by creating as small or as large of a system