



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DEVELOPMENT OF AUTOMATIC SOLAR PANEL
CLEANER USING ARDUINO**

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

by

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APPROVAL

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ABSTRAK

Tujuan utama projek ini adalah untuk membangunkan sistem automatik yang boleh membantu pengguna membersihkan panel PV. Proses biasa untuk pembersihan panel PV ialah menggunakan kaedah manual di mana seorang pekerja yang diperlukan untuk membersihkan panel solar. Panel PV terdedah kepada habuk dan kotoran apabila ia dipasang di kawasan terbuka. Faktor-faktor ini boleh menyebabkan kejatuhan jumlah tenaga yang dihasilkan oleh panel PV. Debu dan kotoran akan menghasilkan sekatan yang menyebabkan cahaya matahari tidak sampai ke sel PV. Semakin tebal debu atau kotoran yang terlekat di modul PV lebih rendah tenaga yang panel PV akan hasilkan. Apabila tenaga yang dihasilkan jatuh kecekapan tenaga juga jatuh. Projek ini akan menyediakan litar yang boleh mengesan perbezaan dalam output voltan panel PV. Ini boleh mengurangkan masa yang diambil untuk memeriksa panel PV satu demi satu. Bagi mekanisme pembersihan, projek ini akan menggunakan pengelap dan air sebagai pelarut. Pengelap tersebut digunakan kerana ia lebih mudah dan mudah untuk dicari. Menggunakan analisis data yang diambil dari sistem, keberkesanan dan prestasi produk akan dinilai dan disimpan untuk penambahbaikan.

ABSTRACT

The main purpose for this project are to develop an automated system that can help user clean the PV panel. The normal process for the cleaning the PV panel is using the manual method where a worker is needed to clean the solar panel. The PV panel is exposed toward dust and dirt when it is install in the open area. All these factor may cause in the energy produce by the PV panel. The dust and dirt will produce a blockade which effect the sunlight ay from reaching the PV cell. The thicker the dust or dirt the lower the energy that the PV panel will produce. As the energy produce drop the energy efficiency are also drop. The project will provide a circuit which can detect the difference in voltage output of the PV panel. This can reduce the time taken to check the PV panel one by one. As for the cleaning mechanism, the project will use a wiper and water as solvent. The wiper is use as it more convenient and easy to find. Using the analyze data retrieve from the system, the effectiveness and the performance of the product will then evaluate and kept for further improvement.

DEDICATION

To my beloved father, mother and family. Also for my lecturer and fellow friends, thank you for your support and help given to me on completing the thesis.

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LIST OF SYMBOLS

V	-	VOLTAGE
R	-	RESISTOR
Voc	-	Voltage at open circuit
Isc	-	Short circuit current

LIST OF ABBREVIATIONS

AC	Alternating Current
ANN	Artificial Neural Network
APL	Arduino Programming Language
DC	Direct Current
GHGs	Green House Gaseous
IDE	Integrated Development Environment
RE	Renewable Energy
PV	Photovoltaic
PWM	Pulse Width Modulation
USB	Universal Serial Bus

CHAPTER 1

INTRODUCTION

1.1 Introduction

Solar energy is the energy that are been obtain from the sun. This process includes converting the sun energy to the electricity for our everyday use. In order to convert this energy, a device call solar panel is use. PV modules work by utilizing numerous devices called a solar cell. At the point when the photon hit a solar cell, the electrons will free from their atom. On the off chance that the transmitters are joined to the positive and the negative sides of a cell, it form an electrical circuit. The electron that had been knocked off the atom will flow through the circuit and will generate electricity.

The most common type of solar panel is photovoltaic solar panel are widely known as PV solar panels. These solar panels are made up by a lot of solar cells. The main composition of solar cell is silicon. By constructed positive layer and negative layer together, it creates an electrical field. PV solar panel generates a direct current (DC) type of electricity. Dc means that the electron will flows in only one direction only, different from alternating current (AC) type of electricity.

Soiling of solar panel can affect the quantity solar energy produced by PV modules. The term of soiling means the accumulation of particle such as snow, dust, pollen, leaves and bird dropping on the surface of the PV module. The higher the amount of soil on the solar panels the higher the drop of voltage of the solar panels.

The purpose of this project is to increase the effectiveness of PV solar panel by cleaning the soil on the solar panel. The project will be using Arduino as a controller to

move the cleaner. As for the method of cleaning a brush, wiper and water are been use. In addition a sensor can also be implements to make the project more reliable.

At the end of this project, a device that can reduce the effect of soiling and reduce the maintenance cost will be produced.

1.2 Background

Nowadays, most country depend on the non-renewable energy for daily activities. Non-renewable energy is an energy that cannot renew itself and it has been nearly deplete. Besides, non-renewable energy also can cause pollution during the extraction of energy. For example, burning of gasoline can cause air pollution. This can harm our environment. For a better environment renewable energy are introduce.

Solar energy or solar photovoltaic (PV) electricity generation is a type of renewable energy (RE) which is perfect, non-exhausting and does not radiate any greenhouse gases (GHGs) since it produces energy straightforwardly from the sun by methods for PV impact (Chua and Oh, 2012). Solar energy can be extract by utilizing a PV modules. Malaysia's power limit through RE remains at 50 MW and it is required to reach around 2000 MW by 2020. The viewpoint past 2020 is that solar energy is anticipated to outperform every other type of RE in Malaysia (Chua and Oh, 2012).

In any case, there are a few factors that can cause a drop in solar energy deliver by PV modules. The temperature of the solar cell has a huge impact on the efficiency of a photovoltaic system, especially in a large system. Therefore, the selection of a location to install a solar PV is very important (Zaini *et al.*, 2016)

Besides, accumulation of dust also can affect the efficiency of the solar panel. The drop of energy deliver because of dust can be viewed as the electrical power output

is lessen altogether (by up to 83%) when outer protections darkened light way of the solar panel (Sulaiman *et al.*, 2014). The greater the quantity of accumulation of dirt the greater the quantity of power drops. The reduction in glass regular transmittance relies upon strongly on the dust deposition density in conjunction with tilt angle, as properly as on the orientation of the surface with respect to the dominant wind course (Elminir *et al.*, 2006).

1.3 Problem Statement

The main idea of this project is how to increase the efficiency of the solar panel. As we all know solar energy had grows larger in these recent years. However, there some problems that happen to occur that reduce the optimization of the solar energy harvest by the solar panel. These problems are includes soiling on solar panel.

Soiling can drop the efficiency of the solar panel. Soiling means that the accumulation of dirt or bird dropping on the surface of the solar panel. In order to return the solar panel back to its original state, the solar panel are need to be clean. However, the solar panel need to check from time to time to making sure that the solar panel are always clean.

This may consume a lot of money to call somebody to clean for us. For example, in a solar farm there are hundred or maybe thousands of solar panel that are needs to clean. This activity may take a lot of time as there are a lot of areas that are needs to be cover. A lot of workers are needed to clean all the solar panels.

Therefore, this project is carried out to fulfill the following objectives:

1.4 Objective

The following are the objectives of this project:

- I. To develop automatic solar panel cleaner using Arduino
- II. To increase the production of solar energy
- III. To reduce maintenance cost for cleaning of PV module.

1.5 Scope of Work

The scope of this study is to develop a prototype to detect dust and clean the solar panels during the setting time in order to maximize the amount of energy harvest by the solar panel. This project will comprise of Arduino microcontroller, motor controller, relay, solenoid valve and operational amplifier. This project will use 6V poly-crystallize PV solar panel. The project application will be more focusing to the industry as there is need to increase the production.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter we will discuss the literature review. This consists of previous similar research or ongoing development regarding to this project that had been made by the others. This incorporate learning from different assets, for example, reference book, daily paper, journal, articles and documentation with respect to the application and research work. This is exceptionally basic to acquire learning and better comprehension on the task.

2.2 Temperature Profile in Malaysia

Malaysia are located in near the equator line. The weather are dry and humid throughout the whole year. Malaysia are made of two part which are peninsular and west Malaysia. However, the whole country will receive the same type of climate. The temperature of the place are depend on the geographical state of the certain places.

The climate conditions in Malaysia are exceptionally ideal for the improvement of solar energy. Both irradiance and temperature have been found to substantially affect the execution of solar cells. In Malaysia, the distinctive topographical states show diverse temperature esteems. As per the Malaysian Meteorological Office, the most reduced temperature was recorded in Cameron Highland as 7.8 °C in February 1978 and the most astounding temperature was recorded at Chuping, Perlis at 40.1 °C on April 1998 (Zaini *et al.*, 2016).

The climate condition in Malaysia is extremely sensible for photovoltaic implementation. This is on the grounds that the climate condition is relatively unsurprising and the accessibility of daylight for in excess of 10 h day by day. As it is conceivable to have around 6 h of direct daylight with light of between 800 W/m² and 1000 W/m², it is now great to consider for the utilization of photovoltaic (Amin, Lung and Sopian, 2009).

2.3 Efficiency of Solar Panel

There are plenty type of solar panel that can be seen in the market nowadays. All these solar panel has different type of construction according to their material. However, the main material for solar panel is the solar cell. The solar cell are important as they convert the solar ray to electricity with the help from a few more material.

The solar cell is a semiconductor device that convert solar energy into electricity. Fundamentally, a solar cell is a p-n junction in a thin wafer of semiconductor. At the point when solar cells is presented to sunlight, the photons with energy more noteworthy than the band-gap energy of the semiconductor are retained and make various electron-holes pairs corresponding to the occurrence irradiation. These carrier are cleared separated and make a photocurrent, affected by the inside electric fields of the p-n junction which are directly proportional to solar insolation (Zaini *et al.*, 2016).

The most use solar panel are mono-crystalline Solar Panels and Polycrystalline Solar Panels. The energy efficiency of a solar panel, the proportion of the power yield to the energy initially conveyed to the solar panel, routinely is utilized to gauge solar PV productivity.