



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DEVELOPMENT A PROTOTYPE OF SOLAR POWERED
SMART WATER WASTE UNIT**

This report submitted in accordance with requirement of the Universiti Teknikal
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(Industrial Automation & Robotics) (Hons.)

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) (Hons.)). The member of the supervisory is as follow:

.....
(Ms. Herlanda Windiarti)

ABSTRAK

Tujuan projek ini adalah untuk mengurangkan pencemaran air dan meningkatkan kadar pelancongan. Untuk mengurangkan pencemaran air sebuah prototaip unit pintar sisa air solar dibina. Dengan menggunakan tenaga suria unit ini mengumpul semua sisa air yang terapung di sungai. Unit mengumpul sisa air beroperasi dengan menggunakan tenaga solar kerana, solar adalah tenaga yang boleh diperbaharui dan tidak memudaratkan alam sekitar. Unit sisa air menggunakan sistem solar photovoltaic luar grid. Sistem solar ini direka bentuk dengan menggunakan kuasa dan beban yang akan digunakan dalam sistem asal. Hasil sumber tenaga dari sistem solar photovoltaic akan digunakan untuk mengoperasikan unit ini. Unit mengumpul sisa air adalah menggunakan teknologi hijau. Prototaip sistem solar photovoltaic luar grid dibina dan telah diuji dalam keadaan sebenar untuk mendapatkan keputusan. Diharapkan unit ini akan mengurangkan pencemaran air dan menyelamatkan haiwan akuatik yang terancam.

ABSTRACT

The aim of this project is to reduce water pollution and increase tourism. To reduce water pollution a prototype of solar powered smart water waste unit was build. This solar powered smart water waste unit collect all the water waste that floating in the river. Smart water waste unit operated by using solar energy because, solar is a renewable energy and environment friendly which is no harm to environment. The smart water waste unit will use off-grid stand-alone photovoltaic solar system. The stand-alone photovolatic system will be design by calculating the power output and load. The power source produce from solar module will be use to operate the smart water waste unit. Smart water waste unit is a go green concept. This off-grid stand-alone photovoltaic solar system was developed in prototype model and the system was tested under real condition. The development prototype of smart water waste unit to reduce the water pollution and save the endangered aquatic animals.

DEDICATIONS

I would like to dedicate my thesis work to the God for his love and blessings. Especially dedicated to my beloved parents and family members. Whose words of encouragement and conjointly for their endless love, encouragement and support throughout the whole period of completing my studies. To my kind and supportive project supervisor Ms. Herlanda Windiarti who have perpetually always supported me and listens to my problems and who's her good examples have taught me to work hard for the things that I aspire to achieve. I conjointly dedicate this work to all my respected lecturers, especially Mrs. Emy Zairah Binti Ahmad and my fellow friends who have perpetually giving encouragements throughout the thesis. I will be able to perpetually appreciate all they have done. I dedicate this work and provides special because of all the people that have helped throughout the complete bachelor degree project directly or indirectly. All of them are my best cheerleaders.

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LIST OF SYMBOLS AND ABBREVIATIONS

| | | |
|-------|---|---|
| DC | = | Direct Current |
| AC | = | Alternative Current |
| PWM | = | Pulse-width-modulation |
| MPPT | = | Maximum power point tracking |
| PV | = | Photovoltaic |
| VMP | = | Maximum power voltage |
| IMP | = | Maximum power current |
| PPSPM | = | Perbadanan Pembangunan Sungai dan Pantai Melaka |

CHAPTER 1

INTRODUCTION

1.0 Background of the Study

Malacca is the historical state of Malaysia and has been listed as UNESCO World Heritage Site since 7 July 2008. One of the tourism attractions in Melaka is a river cruise along the Melaka river canal. So, the cleanliness of the river should be considered in order to maintain this tourism attraction.

Water waste that floating in the river is one of the major problem that occur in most of the water tourism attraction in many places. Whether it is because of irresponsible tourist that throwing anything to the river or it is because of the water flow that came from the rain which taken anything from the land to the river. To overcome this problem, development a prototype of solar powered smart water waste unit is designed and built. The prototype will be develop to real unit in the future. This product is using a renewable energy technology which is came from sunlight that has been captured by solar module as its off-grid power source system to the unit and able to collect floating water waste automatically.

This solar powered smart water waste unit will help to reduce water pollution and maintain the cleanliness of the river. By maintain the cleanliness of river the tourist will be attracted to visit Melaka and the tourist population also will increase. This will help Ministry of Tourism Melaka by few aspects such as economics, social and environment. Economics wise, by tourism local people will get job as tour guide, hotel managements, restaurants, retailer and others. This will generate income to the local people. For social advantages of tourism it will bring out real sense of pride and identity to the community. Tourism will provide financial support to maintain the environment and nature of the place.

This project also will give a huge effect to the environment and nature. As stated before the environment will develop by Ministry of Tourism when there is a large number of tourist start visiting the place. By keep clean the river, using the solar powered smart water waste unit the ecosystem can be maintain, can prevent the aquatic animals from death and also can conserve the endangered aquatic animals.

1.1 Problem Statement

Humans pollute the river by throwing waste into it and also litter on land. The rain water carries the litter from land to river. By pollute the river the beauty of nature destroys and tourism will be affected. Aquatic animal also get affected by the pollution. The waste should be collected and the river must be clean for our future. To overcome this problem, should build or develop a prototype of solar powered smart water waste unit. This unit can collect the water waste automatically.

1.2 Objective of The Study

The objective of the project is:

1. To design an off-grid (stand-alone) photovoltaic solar system.
2. To measure and calculate the quantity of energy produced by solar to be used in the system.
3. Select a suitable water pump to rotate the water wheel.

1.3 Work Scope of The Study

In this project, the focus is mainly on design a off-grid photovoltaic solar system to use in the prototype of solar powered smart water waste unit. The unit is using off-grid photovoltaic solar system, as the power source to operate the smart water waste unit and also as go green concept. To identify the solar module and battery sizing, calculation need to be done using formula. Direct current (DC) from solar panel will be capture by battery using charger controller, then the current will convert into alternate current (AC) as power source to the unit by inverter. Water will be pumped by water pump motor to the wheel to rotate the wheel. Water pump will be selected by its specifications.

1.4 Contribution

The prototype of solar powered smart water waste system help to reduce water pollution and save the ecosystem of the river. This project also will help Perbadanan Pembangunan Sungai dan Pantai Melaka (PPSPM) and Melaka tourism to keep the tourist spots clean and attract more tourists to Malacca.

1.5 Thesis Organisation

Thesis consist of five chapters,

Chapter 2, Literature review, about off-grid stand alone sytem, type of solar module, charger controller, batory type, inverter and water pump.

Chapter 3, Methodology is the overall finding about the solar powered smart water waste unit. Which include literatura review to selecting the material, flow chart of project, design of system and formula to calculations.

Chapter 4, Discussion and result of the project.

Chapter 5, Conclusion and recommendation of the project that can be done in future.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

For this project the literature review is emphasis more on the research to get more understanding about the project. The literature review are search from various source of information from books, journals, and websites. This section is will be discussed about theory, basic principle, general characters and others. The system is used to develop this project is photovoltaic system, inverter and water pump.

2.1 Water Pollution

Water plays and important role in everyday life for all living things on this planet. By polluting the water the humans could facing ‘water crisis’ problems in the future. By the unwanted human activities water pollution is growing in the developing countries. Human activities that cause water pollutions are from agricultural waste, industrial waste and domestic waste (Ramandeep Singh Gambhin, *etal*,2012).

Waste water produced across Asian region is around 142km³ annually. Mainly the rivers are polluted by domestic waste. Agriculture waste also have increase in past few years. It also effect the freshwater ecosystem. Industries are help to grow up country economies but on the other side few industries are throw the chemical waste without treating it. By this problems people may get ill-health or death and also damage the nature (Alexandra E. V. Evans, *et al*, 2012).

2.2 Photovoltaic System

Photovoltaic is a system which convert the solar power into electrical energy. Photovoltaic technology is to generate renewable energy from sun. The attractive features of (PV) panels are the nonexistence of moveable parts. Can design mill watt range to megawatt range using photovoltaic(PV) system. Solar energy is a pollution-free source or energy. When producing current, PV cells need no fuel or it does not pollute the water. Sun is the endless energy source for PV system to producing current (Fatimah Zohra Zerhouni, *et al*, 2010).

2.2.1 Operation

Solar cell convert light energy into electrical energy through photovoltaic process. Photovoltaic effect will occur when light falling on a two-layer semiconductor and it will produce voltage between the layers. The produced output current can be used through external electrical circuit.

<http://micro.magnet.fsu.edu/primer/java/solarcell/>

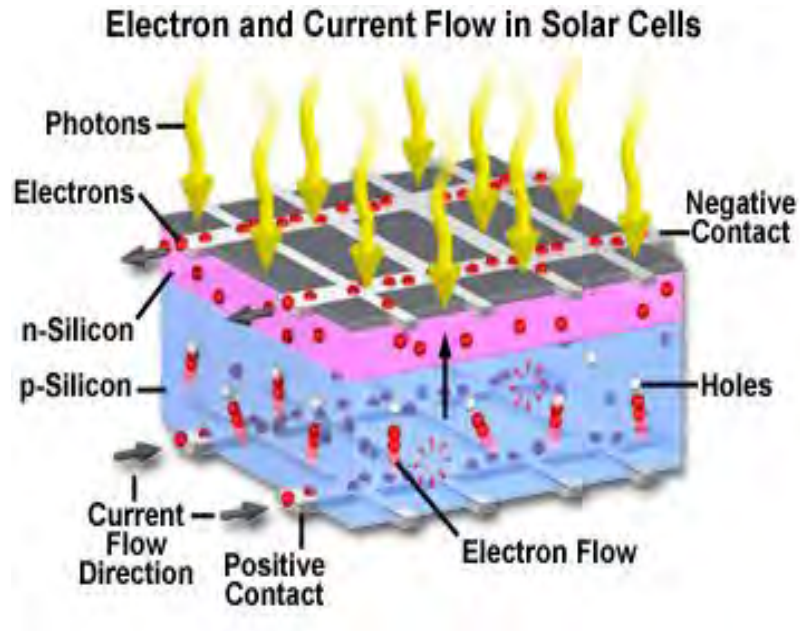


Figure 2.1: Electron And Current Flow In Solar Cell

(Source: <<http://micro.magnet.fsu.edu/primer/java/solarcell/>>)

The Figure 2.1 it shows the electron and current flow in solar cell and the operation. The simplest solar cells have 3 active layers a top junction layer made of N-type semiconductor, an absorber layer a P-N junction, and a back junction layer made of P-type semiconductor. The P-N junction cell has its own built-in electric field, so the electric field provides voltage to force electrons and hole freed by light absorption to flow in their own directions. The electrons will flow to the N-type side, and the hole to the P-type side. The electron flow produce the current, and the cell's electric field causes voltage. With the current and voltage, we will have power.

<http://www.solarbotics.net/starting/200202_solar_cells/200202_solar_cell_physics.html>

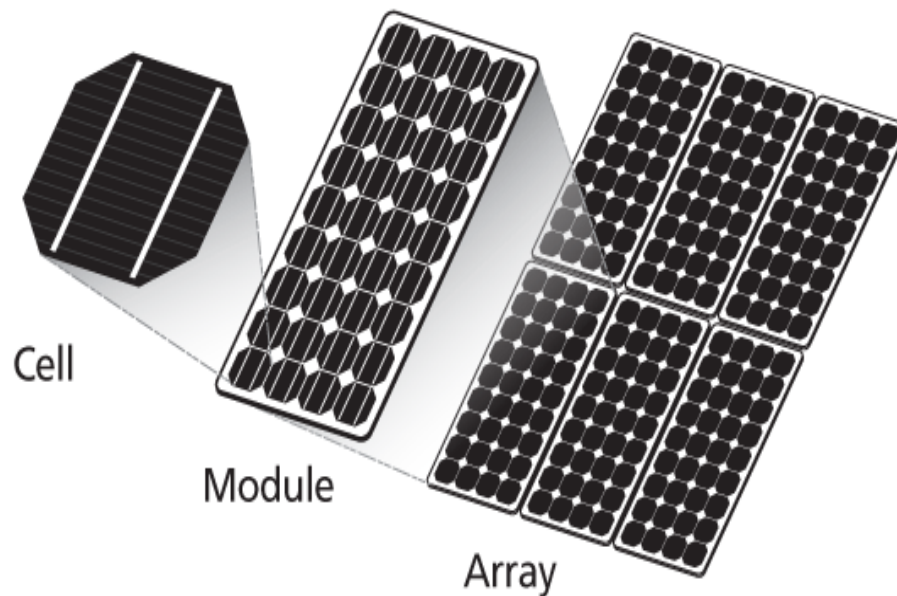


Figure 2.2: Cell, Module And Array

(Source: <<http://www.samlexsolar.com/learning-center/solar-cell-module-array.aspx>>)

The solar cell is semiconductor that convert solar energy into DC electricity through the photovoltaic process. The solar cell produce electricity by absorb the light shines on the cell. As shown in Figure 2.2, the solar cell will connected together and sealed to increase its efficiency. The connected and sealed cell will call as module. The module will connected series or parallel to achieve desire output. The connected module will call as array.

<<http://www.samlexsolar.com/learning-center/solar-cell-module-array.aspx>>

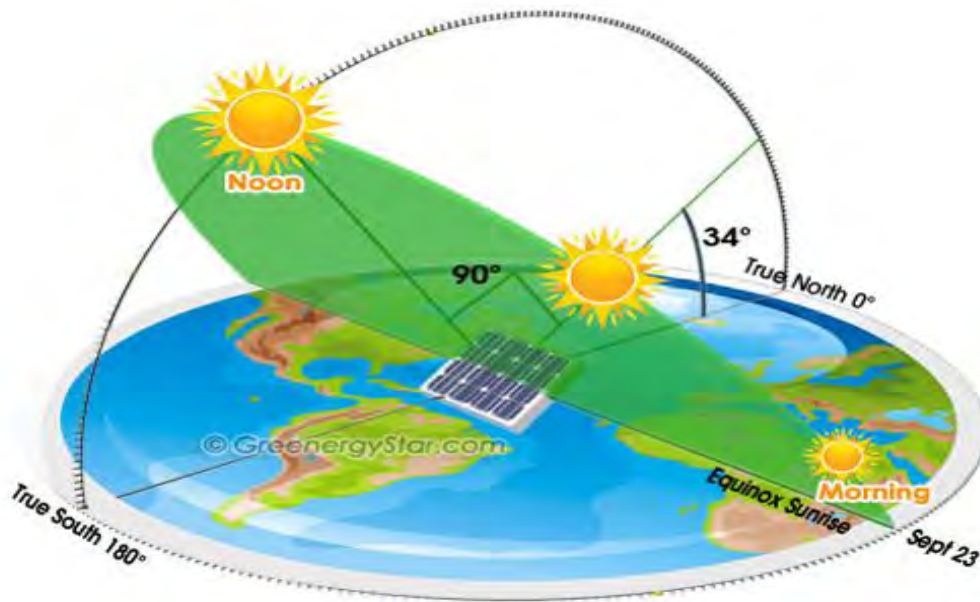


Figure 2.3: The Angle And Sun Path Of PV Module

(Source:<<http://www.greenergystar.com/shop/content/14-optimizing-pv-array>>)

The PV module have to place facing the sun path and suitable angle to get the efficiency output. As seen in the figure 2.3, the PV module will perform maximum when the surface perpendicular to the sun. To capture more sunlight, the PV module should be tilt 34degree from the ground and facing to the south. The green area in the figure shows the path of sun.

<<http://www.greenergystar.com/shop/content/14-optimizing-pv-array>>

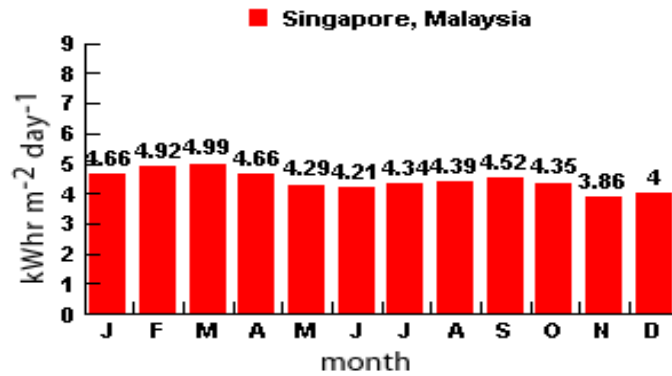


Figure 2.4: The Graf Show Average Radiation In Malaysia

(Source: <<http://www.pveducation.org/pvc/drom/properties-of-sunlight/average-solar-radiation#>>)

In the Figure 2.4 shows the graph of the average sun radiation in Malaysia. The result shows from January to end of year December. The average radiation on a day is 4kwh. The information of graph will be used in the calculation later to sizing of solar module.

2.2.2 Types of Solar Cell

There are few types or solar cells which made from silicon. There is three main type which is mono-crystalline silicon, thin-film and polycrystalline silicon. The difference between this three types are their atomic structure, performance and comparisons as well as other aspects (john Balfour, *et al*, 2013). Mono-crystalline and polycrystalline play important role in photovoltaic system. Other types of solar cell cheaper than mono-crystalline and polycrystalline such as amorphous but when come to efficiency there is big difference (L.A. Dobrzanski, *et al*, 2012). As seen in the Table 2.1 the mono-crystalline silicon have the highest efficiency compare to others (L.A. Dobrzanski, *et al*, 2012).