RENEWABLE ENERGY POWERED AND MONITORING FOR URBANKIT SYSTEM

MOHAMAD FIRDAUS BIN ABU

BACHELOR OF ELECTRICAL ENGINEERING
(INDUSTRIAL POWER)
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MOHAMAD FIRDAUS BIN ABU **2016**

"I hereby declare that I have read through this report entitle "Renewable Energy Powered And Monitoring For Urban kit System" and found that it has been comply the partial fulfilment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power).

Signature : .....

Supervisor's Name : MOHD KHAIRI BIN MOHD ZAMBRI

Date : .....

Renewable Energy Powered and Monitoring for Urban kit System

MOHAMAD FIRDAUS BIN ABU

A report submitted in partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering (Industrial Power)

Faculty of Electrical Engineering
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2016

I declare that this report entitle “Renewable Energy Powered and Monitoring for Urban kit System” is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ……

Name : MOHAMAD FIRDAUS BIN ABU

Date : ……..

To my beloved mother and father

ACKNOWLEDGEMENT

First of all, acknowledgement goes to Allah S.W.T for allowing me to study in a good condition and always give me a pink of health. Next, to my parents Abu Bin Mohamad as my father and RosnahBinti Rashid as my mother and my family that always support during my studies and completing this project and thesis. Then, thanks to En. MohdKhairi Bin MohdZambri as my supervisor that always supervised and advised along the project until the end. My supervisor also gives motivation to burn up my spirit to complete my FYP project and also for contribution on guidance and generates an idea to improve my FYP project and my project clearance. Besides that, thanks to my friends that always give a hand when needed.

ABSTRACT

Nowadays, the increased concern on energy and development of renewable energy source is becoming more and more attractive issues. Renewable energy is a green technology for generating electricity for supplying in the systems. In previous decades, solar and wind power generation have been increased. Both of the energy flow and operation of solar energy and wind energy are capable to create a stand-alone system. Renewable energy as solar and wind has a big potential in contributing to generate electricity. Therefore, the project is conduct to solve the problem that involve in the Urbankit system that need supply electricity from the grid that may cause increasing electricity bill for the consumers. Then, for the use of renewable energy to powered the Urbankit system is to increase reliance of renewable energy in community and also want to increase the awareness of decreasing the greenhouse effect in environment and also for monitoring the efficiency of renewable energy that generate by wind and solar panels. For the main objective of this project is about to study and also design the hybrid renewable energy system using wind turbine and flexible solar panels. Then, the system also capable to monitor the voltage generate by the hybrid renewable energy system to the Urbankit. The Urbankit system also is able to control the level of irradiance supply to the Urbankit hydroponics plant. After that, the method that use to design the system is using manual calculation that studied from the book of designing standalone system and the alternative way is using standalone solar Online calculator. Other than that, the upgrading the Urbankit system is use creativity and own skills. For the significant outcome, the system will able to operate it self that using standalone system and also capable to control the irradiance level apply on the Urbankit plant. At the last of the project is need to testing the system, the testing that need to taking is about the performance of the standalone system supply to the Urbankit, the testing about the performance of the wind turbines and also the level of irradiance supply to the Urbankit plants. The overall studies are about full model of Urban Kit that powered by a standalone system with solar and wind turbine. The recorded result of this system is based on the value of the voltage from the solar and wind turbine.

ABSTRAK

Padamasakini, kebimbanganpeningkatanpadatenagadanpembangunansumbertenagabolehdiperbaharuimenjadiisu.lebihdanlebihmenarikTenagabolehdiperbaharuiadalahteknologihijauuntukmenjanaelektrikuntukmembekalkandalamsistem. Dalamdekad yang lalu, penjanaankuasa solar dananginтelahmeningkat.Kedua-duaalirantenagadanoperasitenaga solar dantenagaanginmampuuntukmewujudkansatusistem yang berdirisendiri.Tenagabolehdiperbaharuiseperti solar dananginmempunyaipotensibesardalammenyumbanguntukmenjanaelektrik.Olehitu, projekiniadalahmenjalankanuntukmenyelesaikanmasalah yang melibatkandalamsistemUrbankit yang memerlukanbekalanelektrikdari grid yang bolehmenyebabkanpeningkatanbilelektrikkepadapengguna.Kemudian, untukpenggunaantenagabolehdiperbaharuiuntukdikuasakansistemUrbankitiniadalahuntukmeningkatkanpergantungantenagabolehdiperbaharuidalammasyarakatdanjugamahumeningkatkankesedaranmengurangkankesanrumahhijaudalamalamsekitardanjugauntukmemantaukecekapantenagabolehdiperbaharui yang menjanadenganangindan panel solar.Untukobjektifutamaprojekinijugaakanmengkajidanmerekabentuksistemtenagabolehdiperbaharuihibrid yang menggunakanturbinanginfleksibeldan panel solar. Kemudian, sisteminijugamampuuntukmemantauvoltan yang dijanaolehsistemtenagabolehdiperbaharuihibridkepadaUrbankit.SistemUrbankitjugadapatmengawaltahapsinaranUrbankitbekalanhidroponikkepadatumbuhan.Selepasitu, kaedah yang digunakanuntukmerekabentuksistem yang menggunakanpengiraan manual yang dikajidarikitabmerekabentuksistem yang berdirisendiridancaraalternatifmenggunakankalkulator solar berdiri Online. Selaindaripadaitu, sisteminimeningkatkanUrbankitkreativitikegunaansendiridankemahiran.Untukhasil yang ketara, sistemakandapatmengendalikannyasendiri yang menggunakansistem yang berdirisendiridanjugamampuuntukmengawaltahapsinaranUrbankitmemohonpadatumbuhan. Padaakhirprojekiniadalahkeperluanuntukmengujisistem, ujian yang perlumengambilkira-kiraprestasibekalansistem yang berdirisendirikepadaUrbankit, thetestingmengenaiprestasiturbinangindanjugatahapbekalansinarankepadatumbuhanUrbank

it.Kajiankeseluruhanpenuhtentangitu model Urban Kit dikuasakanolehsistem yang berdiri sendiri dengan solar dan angin turbin. Hasilnya direkodkan sistem ini adalah berdasarkan kepada nilai voltan dari solar dan angin turbin.

TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Project Background

1.1.1 The Urban Kit System That to Upgrading

Nowadays, agriculture technology is has various type and method. To plant a tree or vegetable without using any of soil it called hydroponic. Hydroponic is a method of planting only use water, mineral, and nutrient solution that dissolve entire nutrient it in the water. The previous technology is using Urban Kit system for planting. The Urban Kit system is a technology that can plant a vegetable in an area which is very limited and small placement like terraced houses, link houses, condominium, apartment, flat and etc. Besides that, the basic operation of the Urban Kit is use the water from the aquarium tank to watering the hydroponic plant. The water is always circulated and flow to the aquarium. This system is use the power from the grid to power up the system. For this Urban Kit, the plant also needs to place under the sun to give irradiance supply to the plant. So that, the new idea about the Urban Kit system is use standalone system to power up system and also capable to applied indoor for planting. The basic idea to support standalone system is using flexible solar panel and wind turbine. Then, the growth light will be used in the indoor system to replacement to the sun. Therefore, to upgrading the Urbankit system that support by the standalone system is need to consider factor of environment and all the equipment need to be use in the system. The factors that need to be consider is explain below.

Figure 1.1: The Urban Kit System

Wind power can be produce from air moving from breeze. From the air moving, it can rotate wind turbine by the air moving through the wind turbine blade. During the sun heats the land, air above also warms and rises up. Cold air then replaces the rising air. This creates the winds that we feel most days. Air tends to warm at a faster rate over land because the land retains its heat. Then, over the sea the air warms more slowly as heated by the sun and slowly cooled by the cold water. This phenomenon is called breeze that always happen near to the sea. The breeze can happen during night and day that called sea breeze and land breeze.

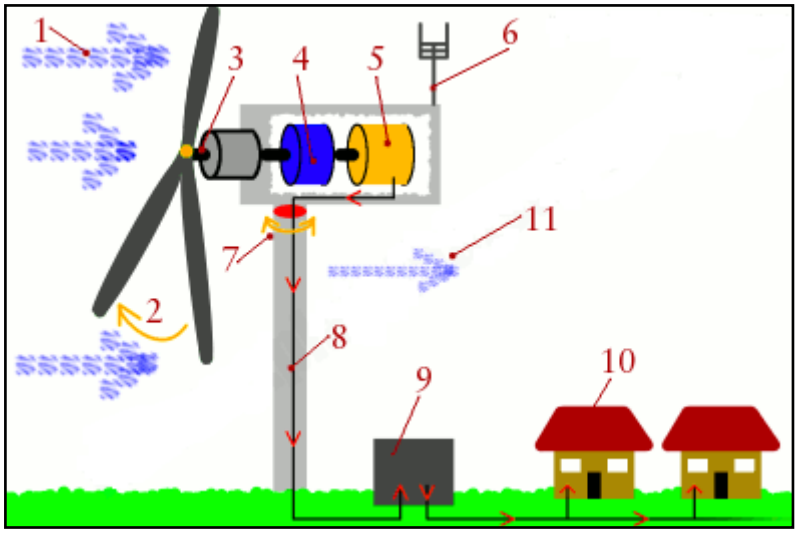


Figure 1.2: Wind Turbine Concept

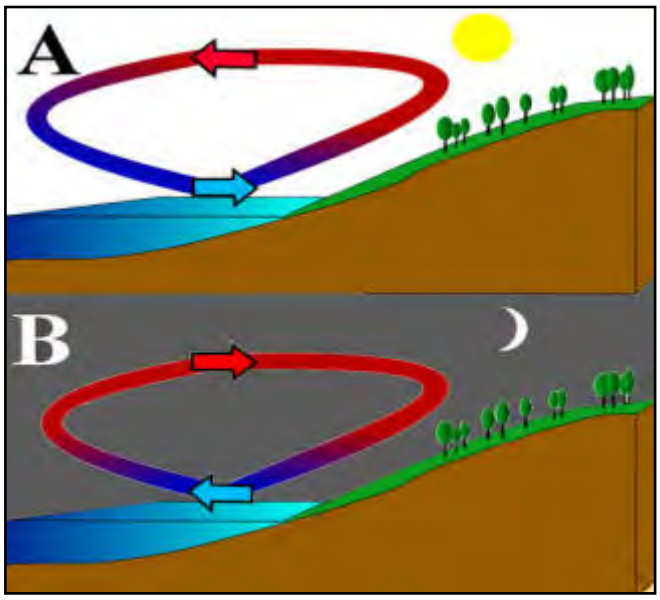


Figure 1.3: Breeze Concept

Malaysia is a country that placed near by the sea, so it has been a good potential to build wind turbine power station around the Malaysia. From the observation about the condition of Malaysia that has enough wind to rotate the wind turbine. Others option can be taken to build wind turbine is wind turbine can be built at sea because don not have enough space on land. Today, many of researchers from the entire world try to find any alternative energy which is safe, friendly, renewal and useful in our daily life. So that wind energy is a one of the best decision to use in Malaysia among the others renewable energy after solar energy. Besides that, wind is a one of the alternative energy to generate electricity if it use in genius method and creatively to create a lot of energy from the wind to support human being. The wind turbine can be built by the own. With the basic skill about the mechanical function of the wind turbine and some knowledge about to store electricity, people can build their own wind turbine that can place it at home.

Nowadays, solar is a one of the source that can be converts the sun light to electricity using solar panels. Solar panel is devices that convert sun light into electricity by through some process in a solar panel. The basic operation of solar panel is like operation of diode that only operates when electron from p-silicon moves to n-silicon hole. The movement of the electron cause the electricity flow from positive terminal to negative terminal and electron flow from negative terminal to positive terminal. A solar panel is a collection of solar cells. Many of small solar cells spread over a larger area can work together to provide

enough power to be useful. The more intensity of light that hits a cell, the more electricity is produces. Solar panel refers to a panel build to absorb the sun's ray as a source of energy generating electricity. A photovoltaic module is a packaged, connected assembly of typically 6x10 solar cells. Then, solar photovoltaic panels contribute solar array of photovoltaic system.

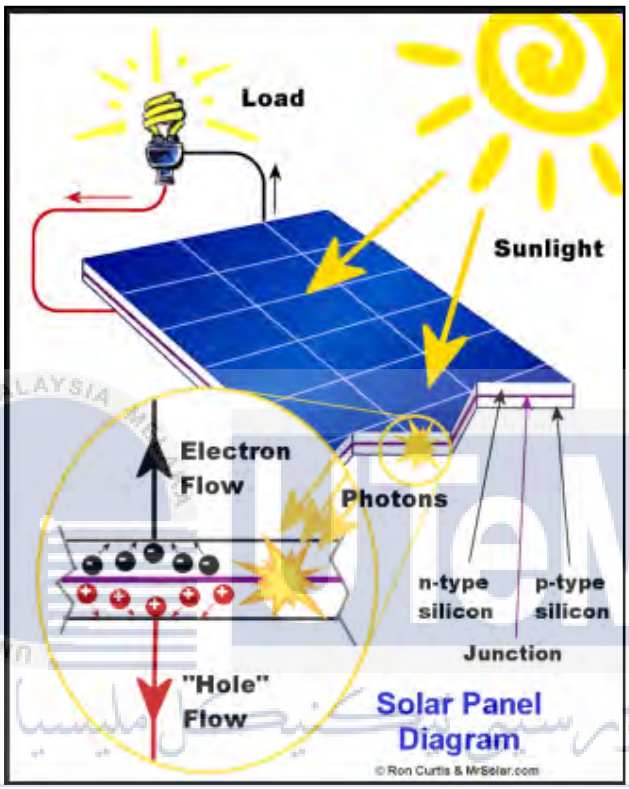


Figure 1.4: Solar panel operation

A photovoltaic module is able to produce electricity from the frequency of light. The other concept is separate the light into deference wavelength range and light emission on the different cell.

So at the end of the process the solar panel will generate energy from the sun light energy and convert to electric energy. Then, the energy is able to store in battery, the process need solar charge controller to store energy generate from solar panel before store it into battery.

Flexible solar panels are lightweight and versatile. It is particularly useful if need a portable solution. Flexible, able to roll and folding/fordable solar panel use amorphous

technologies. Besides that, with no glass they are less fragile and lighter than rigid, frame panels, and perform well under low light condition.

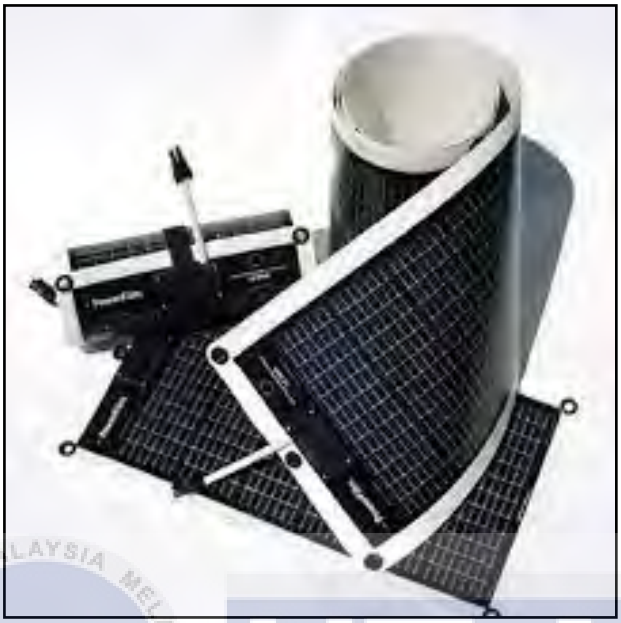


Figure 1.5: Flexible solar panel

Solar panel is only generating power from conversion of sun light beam to electricity, but solar panel cannot store the power from the solar panel. So, to store the power battery is needed for the storage. But, from the solar panel it cannot direct connect to the battery because the solar panel will be a load for the battery. The solution to store the energy is via solar charger controller. Solar charge controller also knows as charge regulator. Therefore, the charger controller is basically a voltage and current regulator to keep battery from over charging and discharging to the solar panels. Basically the solar charger controller is operating to regulate voltage and current generate from solar panel to the battery. So, without using solar charge controller will cause damage to the battery. Besides that, battery also need round 14V until 14.5 V to fully charge.

Figure 1.6: One type of solar charger controller

Basically, the charged controller is no needing for the small system with only supplies little power from the solar panels to the system, such as 1 Watt to 5 Watt panels.

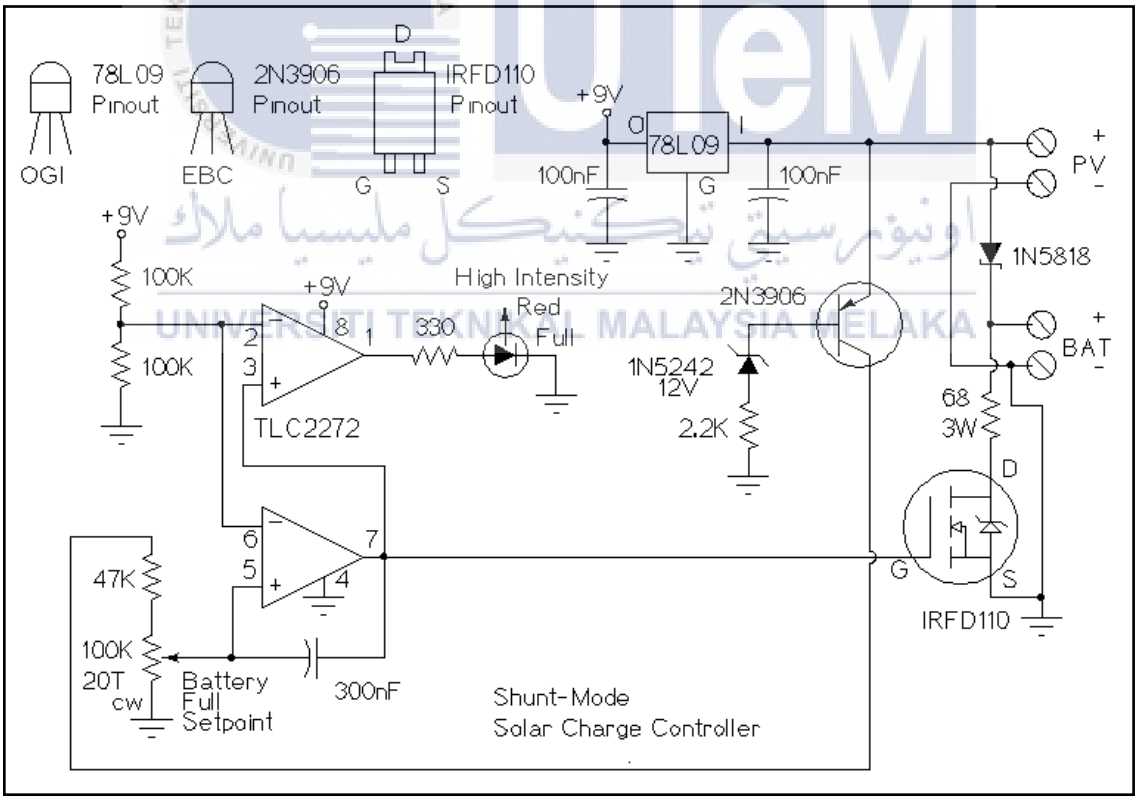


Figure 1.7: Basic operation circuit.

Therefore, the by refer the manual of the charger controller the function is for overload protection, short circuit protection, reverse discharging protection, reverse

polarity protection, protection from lighting strike, under voltage protection and overcharging protection. Then, the solar charger controller has LED indicator. The LED indicator is to indicate the charging status of the battery. The lighting is shown in charging mode and when LED turn off means the charging is stopped.

LED disk light is Light Emitting Diode that is a simple semiconductor that blocks electrical current from flow. The LED only allows electrical current flow in one direction. Besides that, strip light is used in accent lighting, backlighting, task lighting, decorative lighting and etc. LED disk light is designed for indoor and outdoor condition and also to build with waterproof condition. Then, strip light also in flexible condition that able be used with any condition of the place. Most of the strip light use in computer lighting, costume lights, toy, work lighting, display ambient lighting, alcove lighting and etc.

Figure 1.8: LED disk light

Inverter is needed to convert the DC power supply to AC Power. This is because the not all equipment uses DC supply and also not all equipment use AC supply to power up the equipment. So, the power inverter is important for standalone system. Most of the power inverter use power electronic equipment to convert the type of supply from AC to DC or to AC to DC. In the inverter, the important component that use for convert DC to AC is MOSFET, IGBT and etc. the main function for the components is for switching process in high speed to simulate the AC wave form.

Figure 1.9: DC to AC inverter

So, all the equipment and all basic information is state in the description above is need to be use and consider to make sure the system is able to operate properly and the system running at the best conditions.

1.2 Problem Statement

The standalone hybrid system is built to support the Urban Kit**.** The best solution is using flexible solar panel and wind turbine as the renewable or green energy supply sources. This is because the available Urban Kit system used the supply from grid that sometime lack of accessibility especially in rural areas. Besides that, the monitoring for the standalone system also needs to make sure the system in optimize condition.

In action to choose the type of renewable energy that is suitable to be used for this project. The wind energy can be used to generate electricity that has good potential for keep the environment clean during energy is generate. In action to realize the green environment, wind energy is a way to help reduce the greenhouse gas compare then other sources of electricity such as hydro, coal, gas plants, and other renewable energy that can be used to produce electricity.

The purpose of this project is about development a standalone system that use wind turbine consist of DC motor as a generator of the wind turbine and use flexible solar panel as the main electricity supply. This project has been developer because the wind energy has a high potential and the small wind energy and solar panel require the detail

development because it has high potential to be renewable energy for support standalone system in urban kit and also can practice the attitude of green energy generation for the future. The project will be cooperate with MARDI that supply the Urban kit system for the researcher and upgrading to Renewable Energy Powered and Monitoring for Urbankit System.

1.3 Objective

The main purpose of this project is to build a standalone system is:

- To design and hybrid renewable energy system using wind turbine and flexible solar panel in supporting the Urban Kit.
- To monitor the supply voltage by the hybrid renewable energy system to the Urban Kit.
- To control level of irradiance to the plant/vegetable in Urban Kit.

1.4 Project Scopes

The scope that covers in this project is to build a standalone system by using wind turbine and flexible solar panel as the power sources. A simulation of the Urban Kit system is created by using ISIS Proteus Professional 8 software. Hardware development will start with assembling hybrid renewable energy system (the wind turbine by using DC high torque motor and a flexible solar panel) which connected to charger controller. This project will supply to several load such as monitoring system, water pump, and lighting system in Urban Kit.

1.5 Report Structure

For the all of the project progress and the designing system of Renewable Energy Powered and Monitoring for Urbankit System will separate in several chapter that will show the process. The part of the project is including researching and understanding the literature review, design system and methodology of the system, installing the standalone

system to the Urbankit and do several testing, recording reading and analysis for the system performance of Renewable Energy Powered and Monitoring for Urbankit System..

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Renewable energy is also known as alternative energy that uses to generate electricity. The basic concept of alternative energy source relates to issues of sustainability, renewability and pollution reduction. Renewable energy has various forms that are solar energy, wind energy, bio energy, hydro energy, geothermal energy, wave and tidal energy. Wind energy and solar energy is the renewable energy that can be used to generate electricity. Nowadays, wind energy is a source that can generate electricity with significantly. Besides that, using of wind energy as a source to generate electricity can help environment to reduce pollution. Then, solar power is also able to gain benefit from the sun light beam in a days. Solar panel is able to produce electricity to appliance when the energy supply from the solar panel is enough. For this chapter, the main purpose is to study and do some research that including the operation of wind turbine and solar panel use for standalone system.

2.2 Wind Speed Prediction

From the research about wind prediction, an article from A.Kusiak, et.al [1] also agree that the important factor during handling the wind turbine energy converter is wind speed prediction. To build a wind turbine for generate electricity; the speed of wind is a big factor in producing electricity because the energy generate is depends the wind speed. The high speed of the wind it will produce a big electricity. To generate the power generate by the wind turbine for future is needed to planning and schedule the maintenance. Besides that, speed of wind also needs to predict in action to estimate the wind power generation capacity. The prediction of the wind speed is at three time condition that is short, medium

and long term conditions. For the first prediction is short term prediction, the short term prediction is focus on time between 10 seconds or 10 minutes. Then, for the medium term prediction is study the characteristic in an hour's and the long term prediction is involve duration in days. Therefore the short term wind prediction is important in action to control the wind turbine. Then for the medium term prediction is to support the units commitment planning. For the long term prediction is to determine the generating mix and scheduled maintenance. Other than that, the factor that can influence the electricity generation is the dust and dirt that stick on the wind turbine blade if no cleaning process action takes by the consumer.

2.3 Power Curve of a Single Wind Turbine

As inform before, the wind speed is the biggest factor for power generate by a wind turbine. From the theoretical power [2] wind turbine can be extract from the expresses equation (2.1):

$$P = 0.5\pi R^2 \, Cp(\lambda, \beta) V^2 \tag{2.1}$$

Where P in the equation is the theoretical power that generate by the wind turbine from rotating rotor, p is indicate the air density, then R is the radius of the wind turbine rotor or blade length that determine the seeping area, Cp (λ,β) means the power coefficient and V is the speed of wind. Then, air density p at turbine's hub high will remains usually steady for a long-time horizontal. So that, the most important operation of the parameters that impacting the general power area of Cp (λ,β) and V. So, the power coefficient that indicates the efficiency of a wind turbine that capturing the wind energy and also it optimize by the control of the system. [3]

Besides that, the performances of wind turbine need to analyse. The data collected from SCADA at wind farm has been shown in Table 2. Data set 1 with the beginning time stamp "1/1/07 12:00AM" and ending time stamp "1/31/07 11:50 PM". Data shows set 1 were separate into two data subsets, data set 2 and data set 3. Then, data set 2 contains 3476 data points and was used to develop a data-driven model estimating the power curve.

The data set 3 includes of 871 data points and was used to test performance of the model learned from data 2. The data is shown in Table 2.1:

Table 2.1: Description of the data set courtesy of [5]

Data Set	Start Time Stamp	End Time Stamp	Description
1	1/1/07 12:00 AM	1/31/07 11:50 PM	Total Data Set : 4347 Observation.
2	1/1/07 12:00 AM	1/25/07 6:20 PM	Training Data Set : 3476 Observation.
3	1/25/07 6.30 PM	1/31/06 11:50 PM	Test Data Set : 871 Observations.

A generated power by wind turbine is expected will generate a certain amount of energy depend the speed of wind. In a real world, all area of regions outside of the logistic curve represents the power loss and gain. The data points in region away from the logistic-curve region usually represent an anomaly leading to, for example, decrease performance [3].

2.4 Flexible Solar Panel

The solar panel is a technology of green energy. Today, it has many type of solar panel that has been create. Most of the solar panel is able to generate electricity with huge amount. Besides that, the solar panel also capable to stand with extreme condition. The development of the solar panel is start by NASA. For the information, NASA use solar panel to power up the equipment that use in space. Then, most of the satellite around earth is has solar panel on the body of the satellite to generate electricity that need to power up the system in satellite. Then, thin film was manufacture with capability to flexible and to stand with almost all surface condition. The thin film was founded by Dr. Frank Jeffry and Dr. Derrick Grimmer. From the research, thin film solar panels are in variety size and

configuration. The flexible solar panel is manufacture on thin plastic substrate that is as thin as 1/1000th of an inch thick. [4] So that, for this situation the best type of solar panel that can be use is flexible solar panel. Flexible solar panel also capable to generate more effective than others

2.5 Peak Sun Hour (PHSs)

During days, sun will shine at least 12 hours in Malaysia. The peak sun hour is during afternoon withies from 12pm until 1pm. But, the efficient time for producing electricity by using solar panel is in between 11 am to 4 pm during the shine day. Then, solar radiation data is able to get from Meteorological Station in Chuping Perlis. Then, from the research the unit for solar radiation that use is Wh/m^2 or J/m^2, to convert a quantity given in Wh/m^2 to J/m^2. Besides that, the meaning of PHSs is the length of time in hours at a radiation level of 1000 W/m^2 that needed to produce energy equivalent to the total energy in one day or its ratio of solar radiation (Wh/m^2) to solar radiation level of 1000 Wh/m^2 .[5]

Besides that, solar radiation data for year 2006 was found the highest and lowest total daily average solar radiation for monthly minimum, average and maximum solar radiation., the monthly minimum, average and maximum solar radiation, distribution of the average annual daily solar radiation, and its PSHs. The data and information is shown in Figure 2.1 and Figure 2.2:

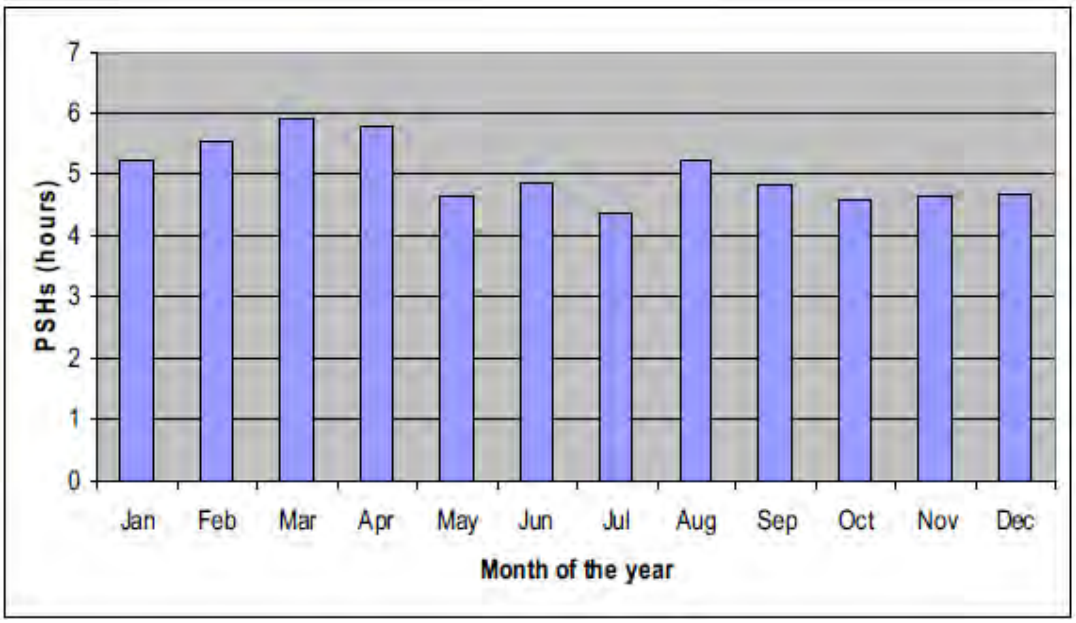


Figure 2.1: Peak sun hour in Perlis for 2006 courtesy of [5]

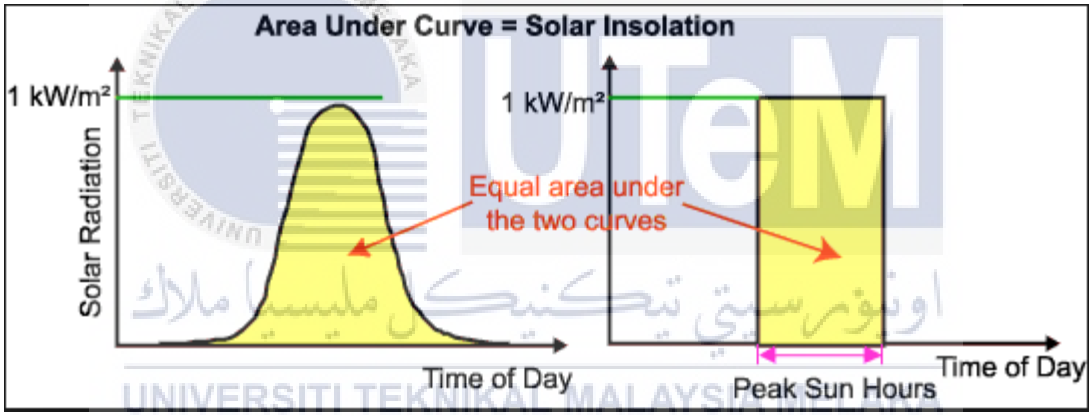


Figure 2.2: Peak sun hour in a day

2.6 The Potential of Wind Speed for Wind Power Hybrid Generation in Malaysia

From the observation from the research, the average of wind speed in Malaysia is around 3 m/s. The data speed of wind is important to assess the wind energy potential. Therefore, wind speed is depending on the environment that cannot be controlled. So, the wind speed is a random variable and inconstant wind speed over a time that shown as probability density functions. Actually, wind speed frequency distribution has been represented by some probability density function such as gamma, Rayleight and Weilbull distribution. [6]

The previous project is the paper presents the analysis of wind speed characteristic in Perlis, northern Malaysia for the year of 2006. The Weilbull distribution function is applied to analyse the speed of wind characteristic and use to calculate the wind power generation potential. The analysis is observed in 24 hour in period on 9th March 2011. The Weilbull distribution is the common method for showing the wind speed observation data. The density function f (v) indicates the percentage of time for wind blow with almost actual speed. [7], [8]

$$f(v) = \frac{k}{c}\left(\frac{v}{c}\right)^{k-1} \; exp\left[-\left(\frac{v}{c}\right)^{k}\right] \tag{2.2}$$

A period of measurement is the mean wind power density is following the wind power density equation [9]:

$$\bar{P} = \frac{1}{2}\rho V^{-3} \tag{2.3}$$

Where ρ is standard air density (ρ = 1.225kg/m^3 dry air at 1 atm and 15^0)

So, the wind speed of the year of 2006 that get from the research is shown in a Figure11. The reading of the mean wind speed during that year is in average 2.4m/s for the maximum speed of wind, 0.3m/s of minimum wind speed and 1.1003m/s for the mean wind speed.

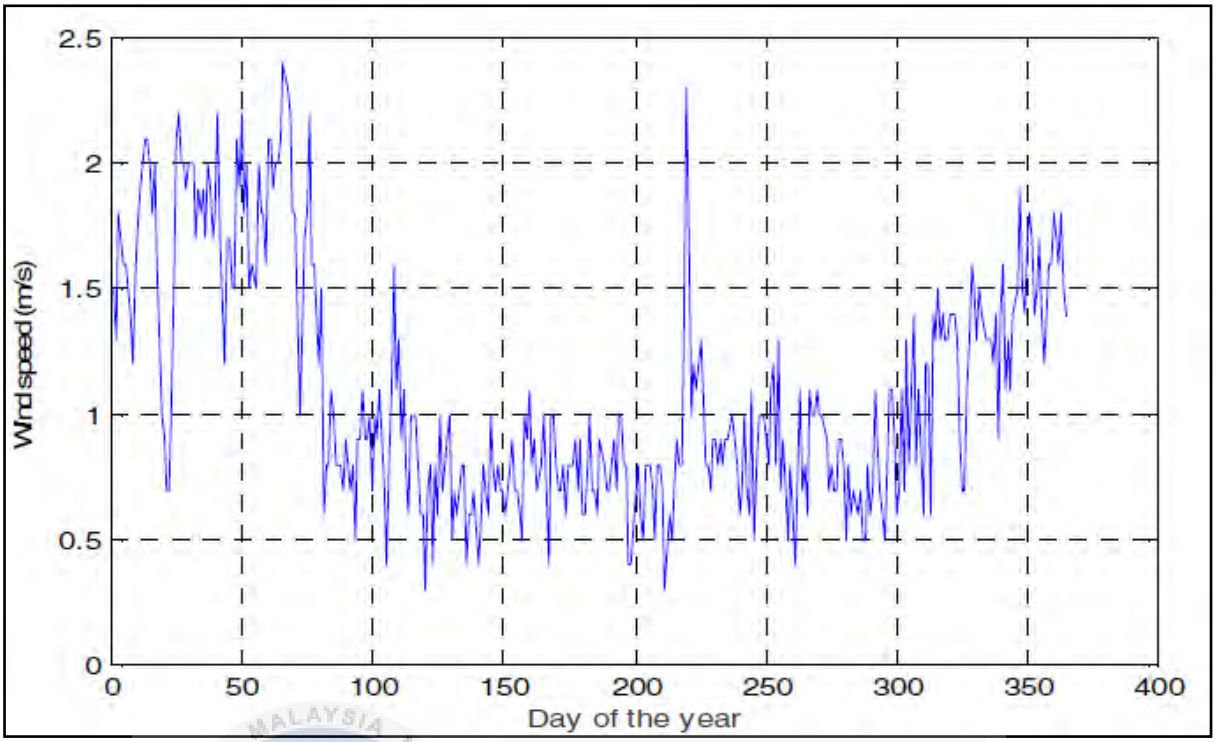


Figure 2.3: Daily wind speed for 2006 courtesy of [5]

The annual Weilbull distribution function data are show in Figure 2.4. The result on 2006 has density probability of around 81.06%, k of 2.49 and the wind speed is around 1.01m/s.

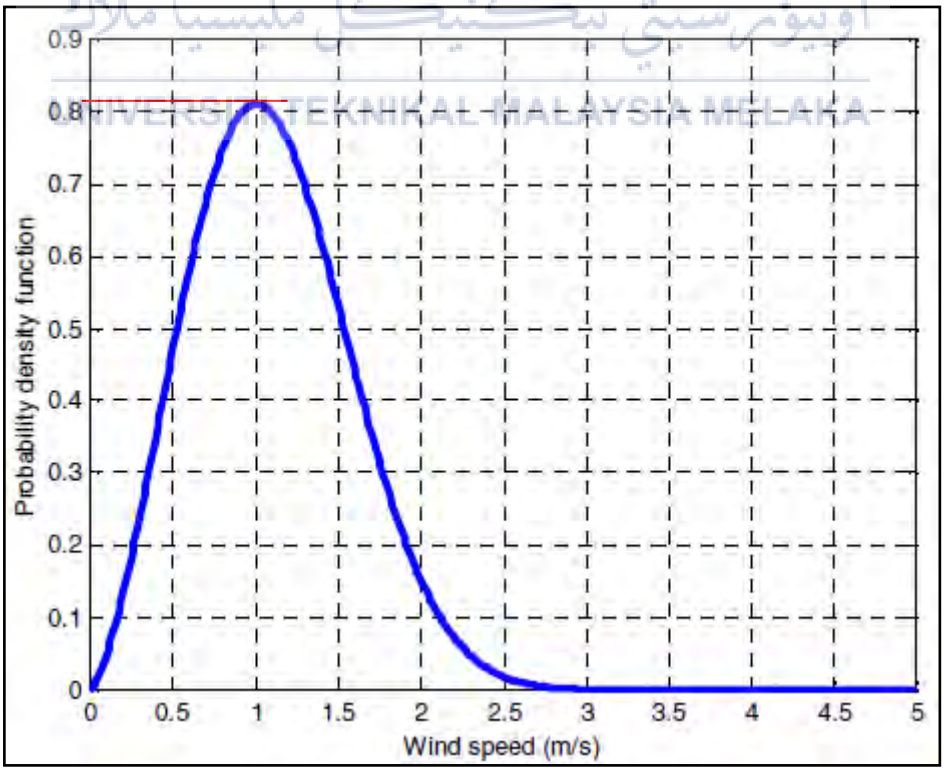


Figure 2.4: Wind speed probability density courtesy of [5]

So, the speed of wind reading that record on 9th March 2011 is show that the maximum speed is 7.61m/s and its average of wind speed is 3.03m/s.

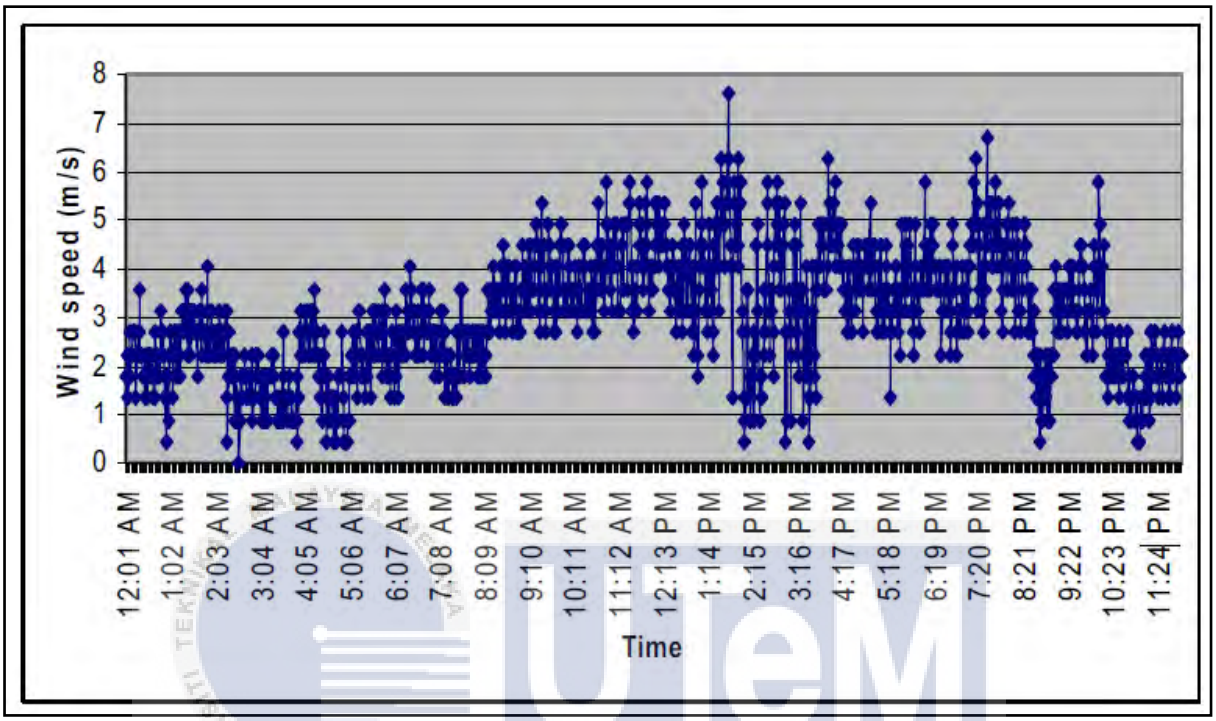


Figure 2.5: Wind speed on 9th March 2011 courtesy of [5]

This is some data of wind speed from other state in Malaysia for a year of 2005. Figure 2.6 show the wind speed in Penang and Figure 2.7 show the wind speed for Melaka

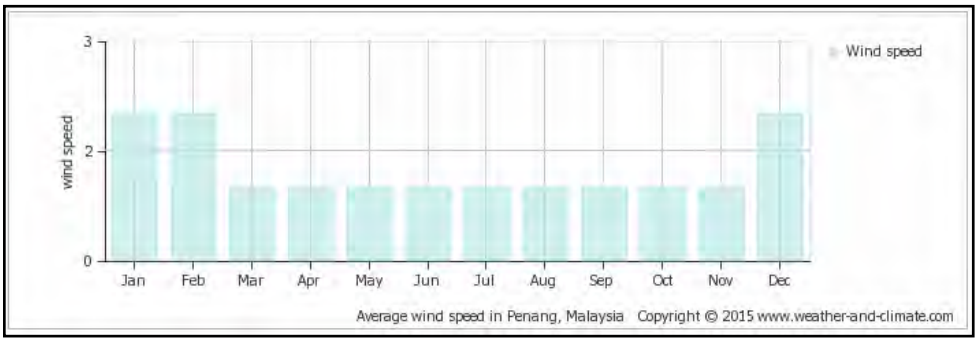


Figure 2.6: Wind speed in Penang

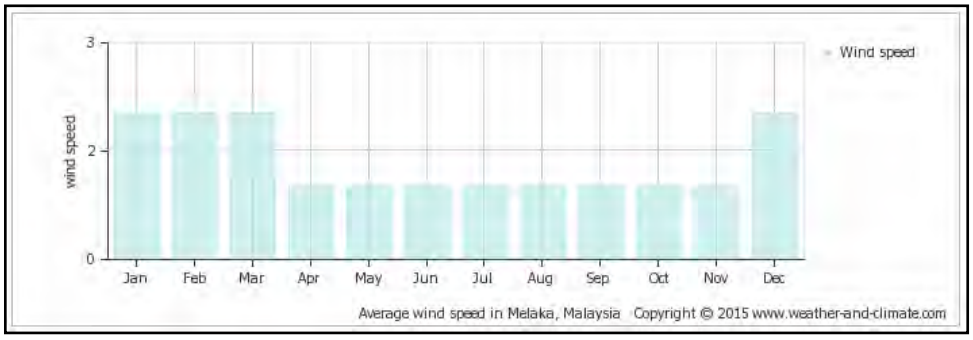


Figure 2.7: Wind speed in Melaka

From the observation of wind speed between Penang and Melaka, the wind speed between both state is almost same with is the wind speed is high between December until March of that year because the monsoon tropical changing

`2.7 Photovoltaic (PV) and Wind Power Hybrid Generation

Solar panel and wind turbine has a high potential to generate electricity that able to contribute in a systems. The potential of solar radiation and wind speed are observe and analysed in duration of 24 hour.

The solar radiation and wind speed are taken by PV solar panel and wind turbine to get direct electricity. [6] The output of the supply from PV solar panel and wind turbine are measured per minute using Electrocorder. PV solar panel and wind turbine power hybrid generation consist of Photovoltaic array and DC motor. DC motor is needed to build a wind turbine, the mechanism in the DC motor is able to generate voltage during the stator or turbine blade of the motor is rotate. The rotation will cause induce during the winding cut the magnetic flux in the motor and that will generate electricity during the rotation.

Figure 2.8: Weather station courtesy of [6]

Figure 2.9: PV solar panel and wind turbine courtesy of [6]

2.8 The Hybrid PV-Wind System Developed at Faculty of Electrical Engineering (FKE)

From the previous project of Development of Hybrid Photovoltaic-Wind System for LED Street Lighting that conducts by M.N.M Nasir, M.H. Jali, M.A.R. Rashid, M.F. Sulaiman, Z.H. Bohari, and M.S. Yahaya the lecturers in FKE. The project is developing hybrid system and investigation of output energy that will produce from the prime energy

that is PV solar panel and wind turbine systems supply it to LED light as the load of the system. The system will control by solar charger controller and hybrid chargers were used. [9] Then, the power that was generating from PV solar panel and wind turbine will be store in the rechargeable battery before supply it to the LED street light.

The PV-Wind hybrid systems are developer of six components which are wind turbine, solar panel, solar charger controller and hybrid charger controller, LED Street light and battery banks. Figure 2.10 is shown the model for Hybrid PV- wind system at FKE.

Figure 2.10: Hybrid PV-Wind System installed at FKE courtesy of [9]

2.9 LED Disk Light Use for Supply Irradiance to the Plant

For the research about used LED disk light as irradiance supply was meeting with an article about the project that use LED disk light to light up the *Griffithsiapacifica*Kylin plant that is category of red marine alga. Matilda L. Madden investigate the effect of irradiance on the short term growth rates of two strains of *Griffithsiapacifica*Kylin. From the research the lighting is needed to all types of green plant. Green plant need sun light to

run photosynthesis process to growth. The method use for the experiment is natural light and temperature measurements. The experiment is separates with three conditions of the level of light with is low light, medium light and high light conditions. Then, during the experiment also the temperature is measured in interval every 10 minutes in 24 hours of the experiments. The result that gets from the emitting light to the plant with different intensity with is 8, 16, and 25 µmol/m^2/s. All the experiments is give a different result that is only small growth rate for a low light intensity with 8 µmol/m^2/s, big growth rate for medium light intensity with 16 µmol/m^2/s and biggest growth rate for the high light intensity with 25 µmol/m^2/s. The experiments was shown the grown in intensity of 5-10 µmol/m^2/s.[10]. Besides that, for the green plant the daily average irradiance is around 26 mol m-2day-1. [11] Then, the ratio of total irradiance of Photosynthetically Active Radiation(PAR) is 0.50 or less W m-2/µmol m-2 s-1 to reduce the thermal heating effect on the plants. So that, the low temperature light need to use in the growth chamber to make sure the plant is no damage during the irradiance supply to the plant. The LED is best choice to use in the system that to supply irradiance to the plant without harm the plant. Therefore, this research able is important information for the urban kit system that also use disk light to light up the plant and be irradiance supply.

Figure 2.11: Plant with growth light LED

2.10Summary and Discussion of the Review

In previous related projects, there so many research and project that has been done by the engineer and intelligent people. The research can introduce the method and technique to minimize the probability to failure. By referring the literature review, most of the previous project is use solar panel and three phase motor for wind turbine. Besides that, from the project of Hybrid PV-wind power system development the information gain is the wind turbine and solar panel need different charger controller that is solar charger controller for solar panel and use hybrid charger controller for wind turbine. Then, from the understanding of the research before the charger controller able to replace by only use of one type of charger controller that is wind/solar hybrid charger. Besides that, the types of generator that use for wind turbine mostly use three phase motor with ac generator. From the observation, maybe other type of generator can be used in this standalone Urban Kit system. The type generator mean is dc generator because dc generator able to supply direct dc sources to the system without using inverter that convert ac to dc source. In the bombshell, the method of using dc generator is way causing some problem to store the energy into the battery because the rated power is low. Table 2.2 below is show the comparison of type renewable energy compare with hybrid standalone system

Table 2.2: Comparison of type renewable energy compare with hybrid standalone system

	Solar energy	Wind energy	Hybrid energy (Solar + Wind)
Efficiency	5% - 10%	42%	47%
Renewable	yes	yes	Yes
Operating cost	moderate	small	Small
Capital cost	large	moderate	Moderate
Suitable for limited space	Not suitable	suitable	suitable

CHAPTER 3

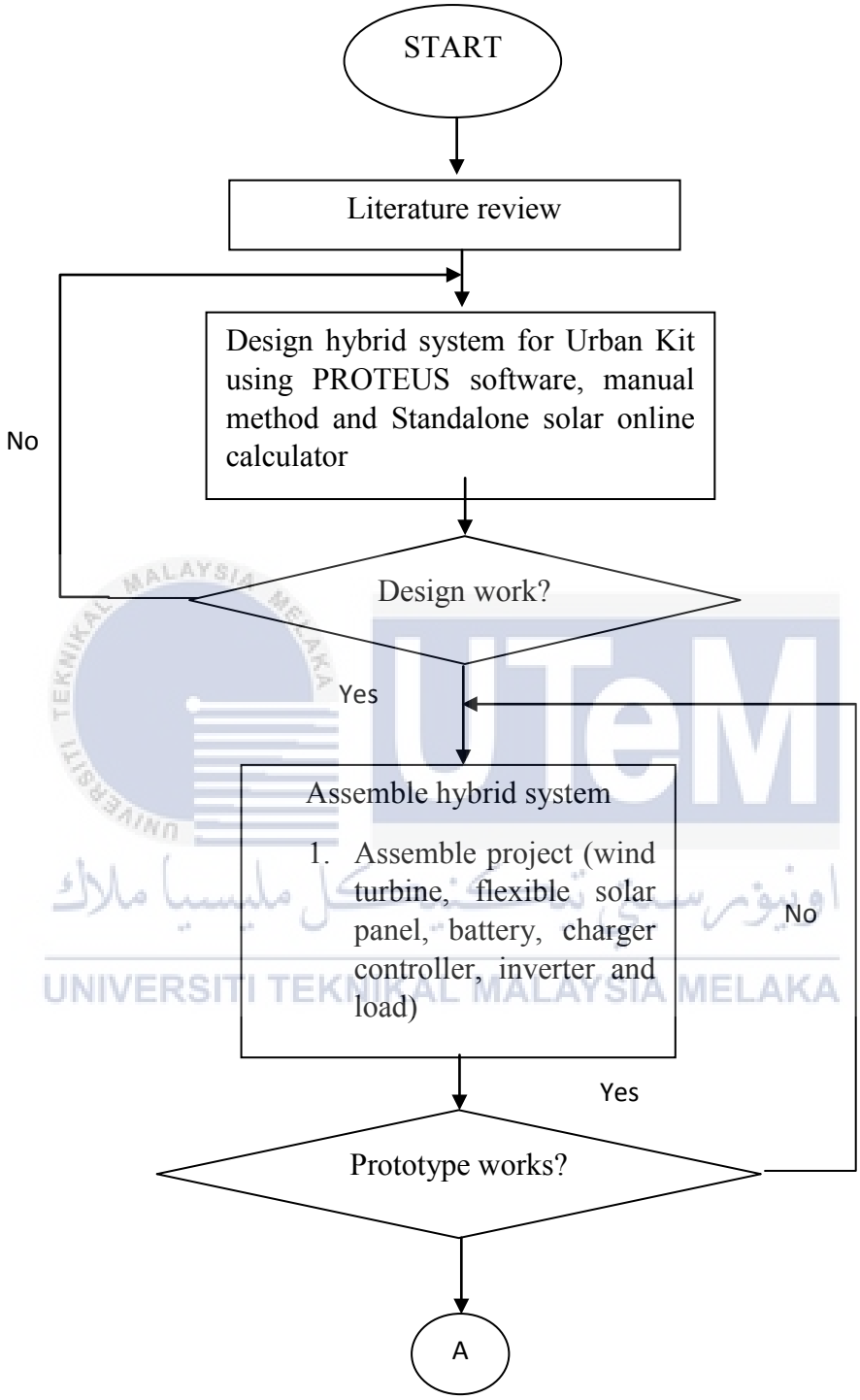
METHODOLOGY

3.1 Introduction

In this chapter, a brief discussion and explanation on methodology of the project approach performed in the study. Then, it will be divided into several sections to give a detail explanation about the methodology of the development of renewable energy powered and monitoring for urban kit using flexible solar panel and wind turbine.

3.2 Flow of Project

The flow of the project of renewable energy powered and monitoring for urban kit system is showed in Figure 3.1. At first, after the selection of the final year project topic done, the researcher is about the stand alone system using renewable energy like flexible solar panel and wind turbine. The literature review done first in order to understand more details about the overall scope of this study. This research focused about the renewable energy that using flexible solar panel and wind turbine for support standalone urban kit system and monitoring the energy supply to the system. Figure 3.1 shows in specific about the flow of the project in the Final Year Project.



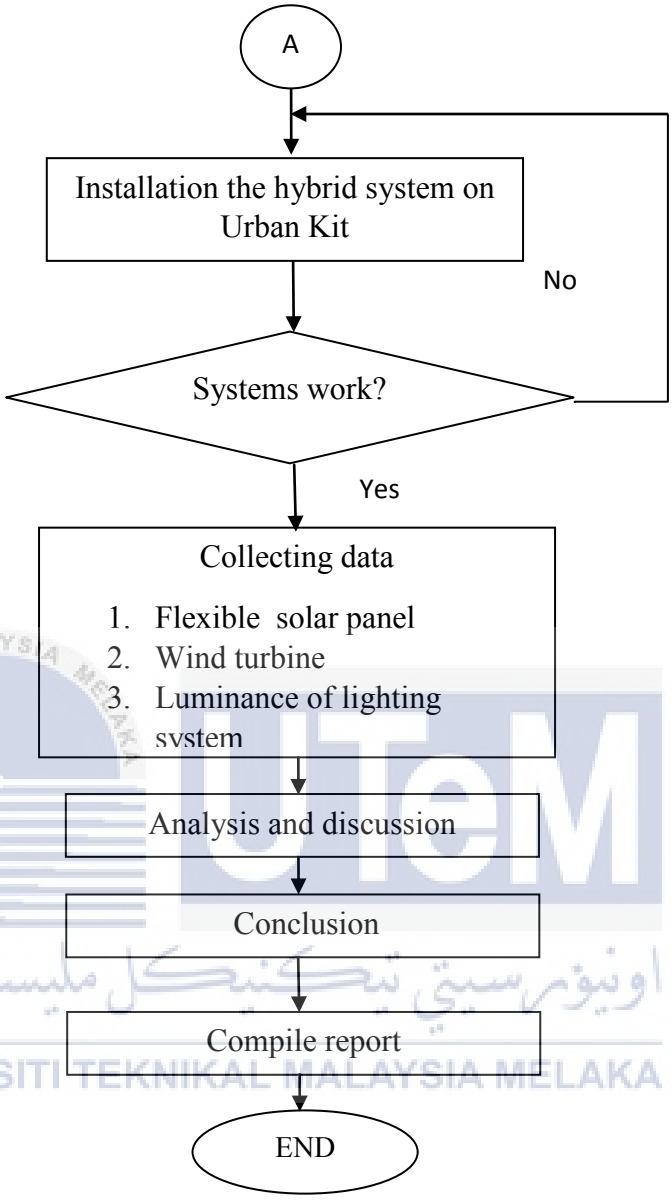


Figure 3.1: Flow chart of methodology for entire system

3.3 Simulation Design of Support System of the Standalone in Urban Kit System Using PROTEUS 8

The project is starting with designs that simulate the system of Urban Kit with standalone system. The simulation using PROTEUS is a best way to simulate the complete system that functioning of the standalone system in Urban Kit. Besides that, in the simulation is only show the system function circuit. For the supply using flexible solar and

wind turbine is another circuit that direct from renewable power supply to battery through charge controller. Therefore, charger controller is a system circuit that help to control the power supply from the flexible energy and wind turbine is store in battery without damage the battery. If the flexible solar panel and wind turbine connect direct to the battery, the solar panel and wind turbine will be the load for the battery and battery will take action as supply to the flexible solar panel and wind turbine. The simulation is shown in Figure 3.2.

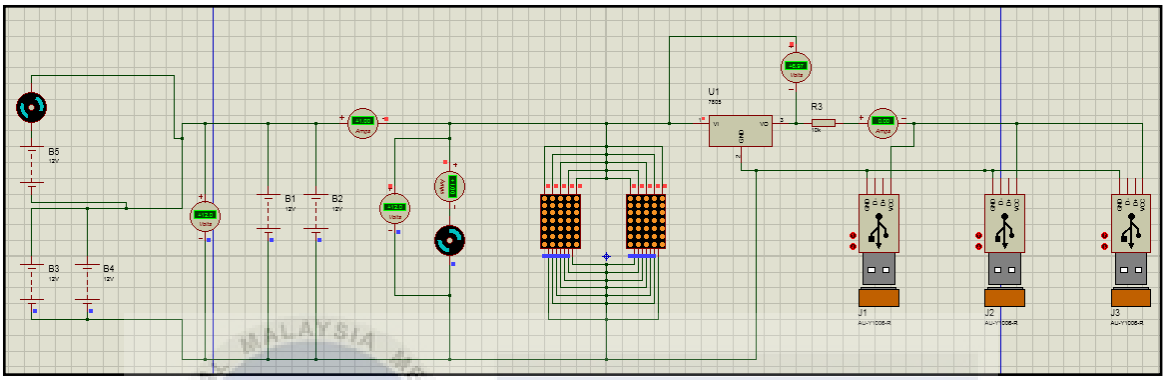


Figure 3.2: Simulation of Urban Kit system

3.4 Experimental Design and Modified For A Support System with Wind Turbine

The project is start with modified DC motor shaft to make the shaft more suitable for fan blade as the turbine. The DC motor shaft was grind down to fit the shaft with other shaft that suitable for the fan blade. The basic information of the DC generator in this project is the rated value is 12V at 15600rpm. That means the generator needs to rotate 15600 rpm to produce 12V supply to the system.

Figure 3.3: DC motor high torque with modified shaft

The motor shaft now is able to use with fan blade that can rotate freely when wind go through it. This design is only suitable for prototype and may not get the maximum speed for the motor to rotate. For the real model the blade must create using Solid Work software. The blade must be suitable for horizontal wind direction that need long blade that can move with the own momentum when it start to rotate. But, for this prototype of wind turbine the blade is only use normal fan blade as the turbine blade. Then, the normal fan blade is installing to the DC motor shaft that has been modified before. The fan blade will be lock by the screw to the motor shaft. After that, the wind turbine generator is done to install to the modified stand that suitable for the wind turbine.

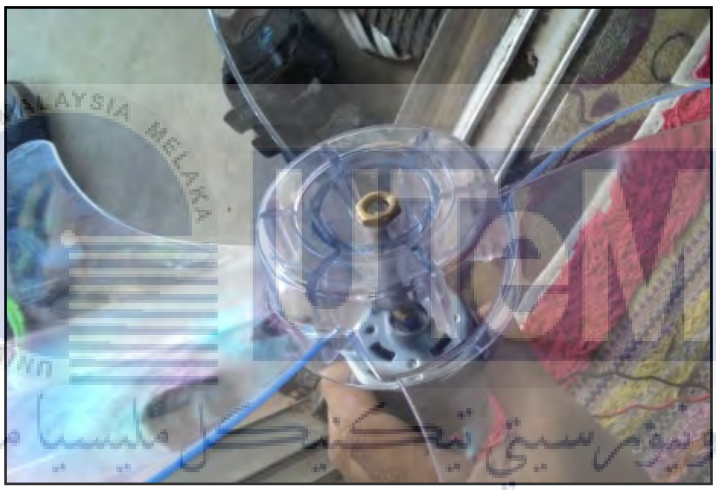


Figure 3.4: Top view for wind turbine

Figure 3.5: Side view for wind turbine

The Figure 3.6 below is show the complete of wind turbine model that install to the flexible solar panel.

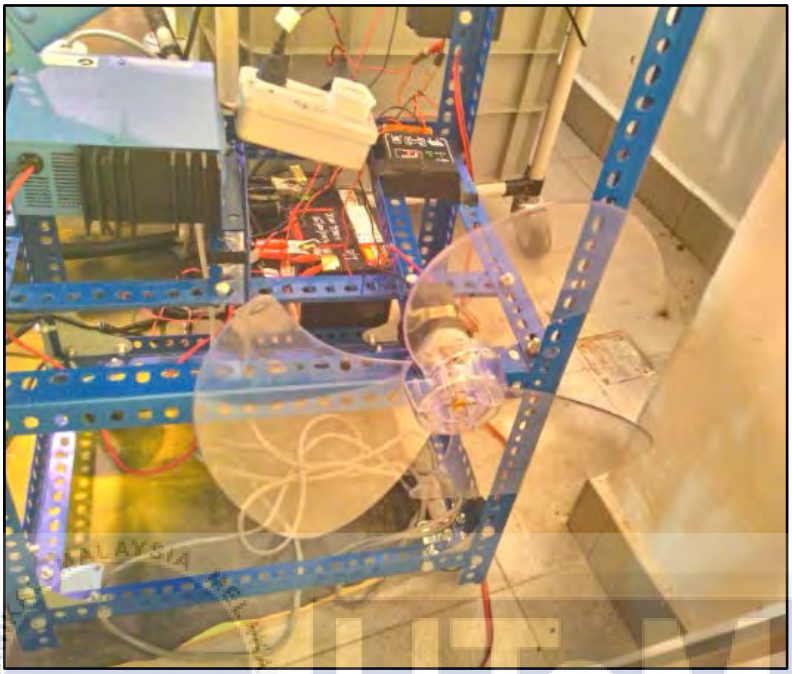


Figure 3.6: The complete wind turbine model

3.5 Experimental Design for a Support System with Flexible Solar Panel

For the stand alone system, choosing solar panel is a supply is effective way to generate energy from sun and store it to battery through solar charge controller. In the action to build green technologies and renewable energy, the solar panel also the best choice for green technologies. For this project the flexible solar panel or thin film is apply in Urban Kit with standalone system. Thin film is a depositing one or several thin layer of photovoltaic cell onto a substrate is the basic gist of how thin film solar cells are manufactured. [12] The advantages of flexible solar panel is cheaper to manufacture than crystalline based solar cells, flexible characteristic that able to stand with any surface condition and have potential to many new potential application and also high temperature and shading have less impact on solar panel performance.

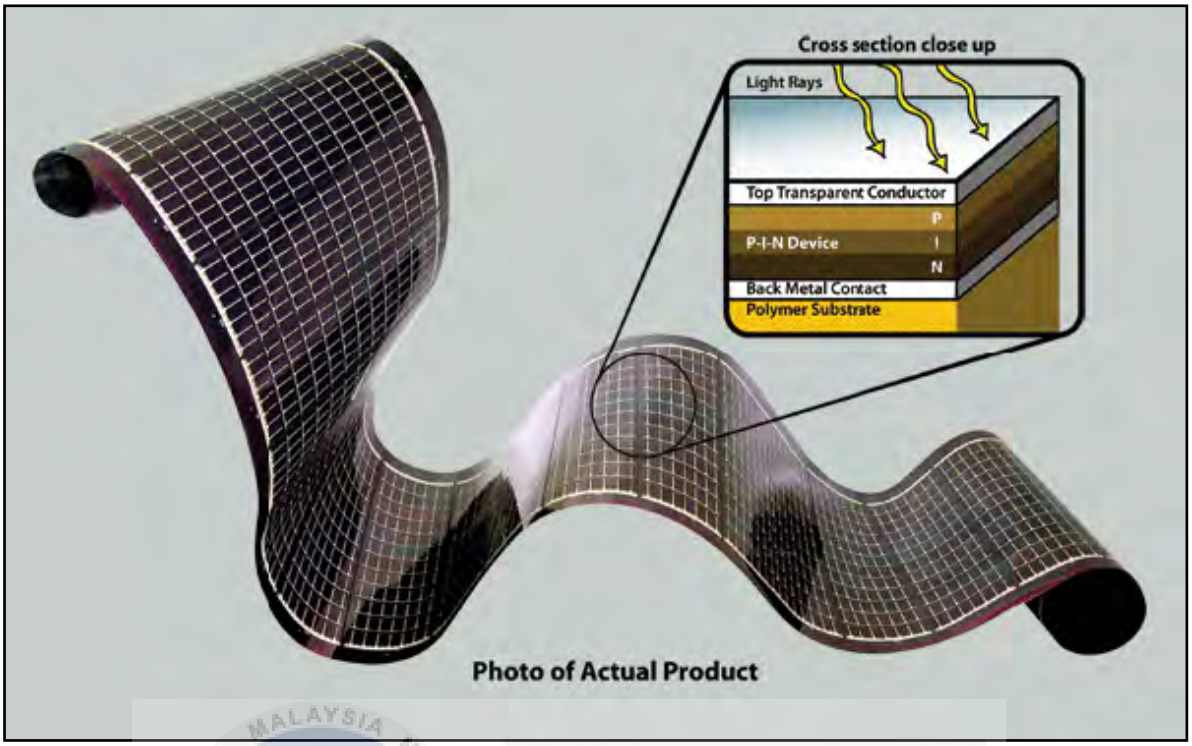


Figure 3.7: Flexible solar panel

For the complete model of installing flexible solar panel, the flexible solar panel is place on the stand that can be easily to move from other place to another. The capability to be placing at every place is able to make the installation easier. The Figure 3.8 shows the complete model that placing the flexible solar panel to supporting the standalone Urban Kit system.

Figure 3.8: The complete model of installing flexible solar panel

3.6 Installation of Solar Charge Controller

Solar charge controller is needed when using solar panel to charge a battery. For this system, the solar charger controller is connected from output of the flexible solar panel and wind turbine. The main function of the charge controller is to protect the battery from overcharging and avoid solar panel and wind turbine becomes the load of the battery. The basic operation of the solar charger controller is effectively cut off the battery voltage reached a certain level. Figure 3.9 show the example of solar charger controller.

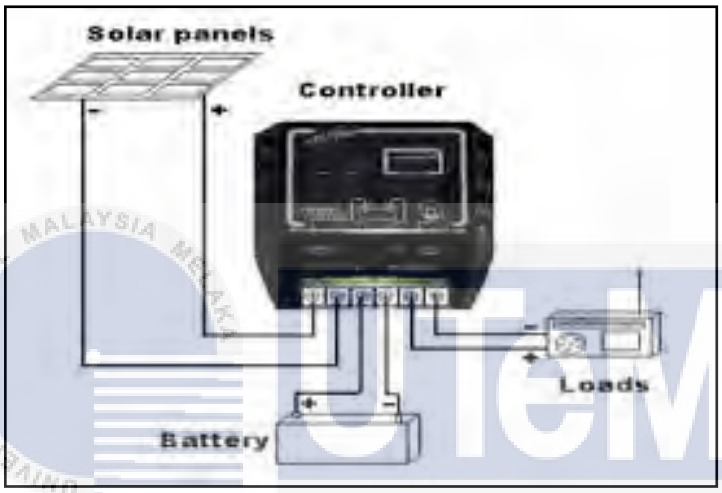


Figure 3.9: Solar charger controller with simple circuit.

Then, for the model of complete installation of the solar charger controller with completely connect to the flexible solar panel and the wind turbine is shown in the Figure 3.10.

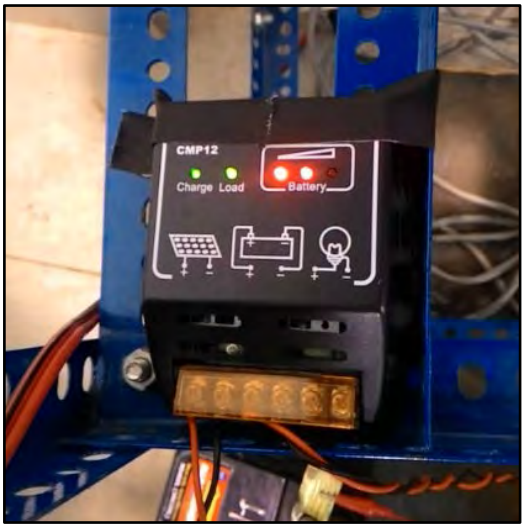


Figure 3.10: Solar charger controller with attach to the system.

3.7 Energy Storage Using Rechargeable Battery

For this project the best way to store the energy is to store it into battery. So, the rechargeable battery is the best choice to be use in the stand alone Urban Kit system. The characteristic of rechargeable battery is able to withstand repeated deep discharging to 50% of capacity without damage the battery itself. This battery is required as little maintenance as possible. Then, the battery capacity is measured in amp-hour (Ah). Besides that, battery also is suitable for charging using flexible solar panel and also has technical viability that system must be able to perform required level that only allow 20% less solar energy availability indicated by data to ensure reliability. The battery characteristic that been used is two units of 12V battery with 7Ah with 60% depth of discharge.

Besides that, for the stand alone Urban Kit system the type of battery connection is in parallel. Parallel connection for battery will produce same rating of voltage and increasing the current by two times. The battery is rechargeable that can support Urban Kit system when no charging operation happen for at least five days.

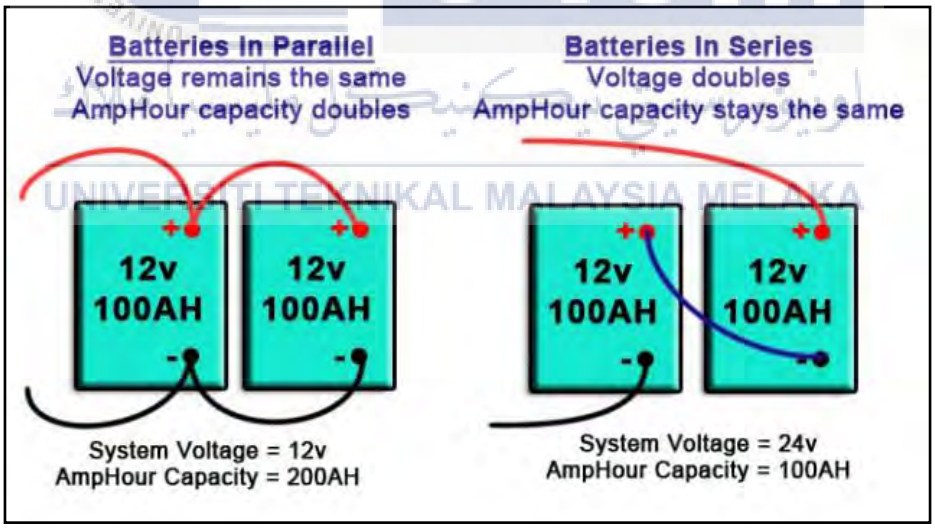


Figure 3.11: Type of battery connection for the system

The battery used is rechargeable battery that will support the entire load that need to run the Urban Kit system. Figure 3.12 shows the battery that attach to the system and support all power need by the system.

Figure 3.12: Battery that supply power to the system

3.8Installation of LED disk light as the irradiance supply for the Urban Kit System

The irradiance supply for the Urban Kit system is use LED disk light. LED disk light is used because the energy saving and the efficiency of the light. In this project, the LED disk light is place on the top of the project to radiate to the hydroponic plant. This is because every green plant need sun light to do photosynthesis process. From the research, the green plant needs irradiance average of 26 µmol/m^2/day. Then, the total irradiance need by the plant is generally over the range 280nm to 50000nm that is need supplement lighting produce about 0.6Wm-2 of total irradiation for each µmol/m^2/s of PPF.

The LED disk light is installed to the frame of the roof of Urban Kit that will concentrate the beam to the plan in the Urban Kit. Figure 3.13 shows the LED disk light install to the Urban Kit system.

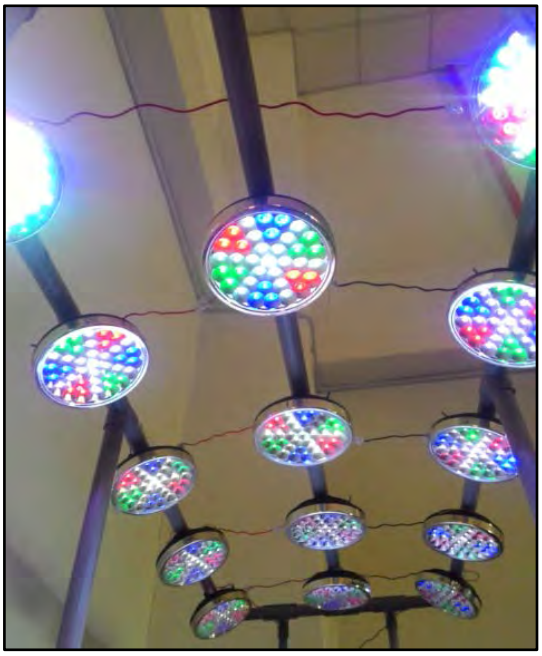


Figure 3.13: The LED disk light install to the Urban Kit system.

3.9 Installation of Mini Voltmeter to the Input of Solar Charger Controller

For the monitoring device, the mini voltmeter is used to detect the value of volt generate by the wind turbine generator and flexible solar panel. Besides that, the applying of the mini voltmeter is able to detect if whether the flexible solar panel and wind turbine generator in good condition or not. The type of mini voltmeter is specific by 0-56' DC 0V-30V Voltmeter-Red-LED-Display Voltmeter the picture can refer Figure 3.9 below. By installing this equipment, user also know when to schedule maintenance and cleaning service for flexible solar panels and wind turbine generator. This is because all kind of solar panel need to clean time by time to remove dust and other waste that stick on the panel that will cause decrease the effectiveness of the solar panel. It also same to wind turbine generator, the blade of the wind turbine also must be clean to make the blade rotate freely without carry unneeded weight. Therefore, this is important to optimize the electricity generate.

Figure 3.14: 0-56’ DC 0V-30V Voltmeter-Red-LED-Display Voltmeter.

The installation of the mini voltmeter was modified to the suitable casing that able to placing that the Urban Kit system. The modified voltmeter is shown in Figure 3.15.

Figure 3.15: The modified mini voltmeter attach to the system

3.10 Installation Of DC to AC Inverter

The function of the inverter in this system is used to convert the DC type of power supply to AC type of power supply. In this Urban Kit system is use AC type of water pump in the system. So, the inverter is very important to make sure the AC water pump is able to

running using standalone system that use battery to store the energy from the solar panel and wind turbine.

Figure 3.16: DC to AC inverter

The inverter that use in the system has a rating of 800W. The inverted that has been use is covert from 12V of DC supply to 240V of AC supply. Figure 3.17 shows the inverter is capable to convert from 12V of DC to 240V of AC.

Figure 3.17: The inverter used in Urban Kit system

3.11 Complete Standalone System Design With Connect To Urban Kit

The system is done by connecting the output of the flexible solar panel and output of wind turbine to charger controller. The rechargeable battery need to connect to the output of the charger controller. The connection of the output wind turbine and output of flexible solar panel is connect together before connect to charger controller. Then, the output of charger controller will connect to the battery for charging process. From the information before, the charger controller will secure the battery from overcharging and others factor that may harm the battery life cycle. After that, the battery will connect to the all equipment that need electricity supply. Then to power up the system, battery is connected to the water pump, LED disk light, and to the female USB port for the supply of monitoring system in Urban Kit. For the USB female port, the supply need 5V voltage regulator to limited the 12V supply from damaging the monitoring sensor and system that mostly use Arduino. This is because Arduino only need 5V of supply, so the regulator makes the supply suitable for the Arduino. After that, mini voltage regulator also placed at the input of charge controller to measure and monitoring the voltage supply to the system and also as the indicator for the user to cleaning and do maintenance to the wind turbine and flexible solar panel when the voltage generate is sceptical. Then, at the LED disk light also place a switch that make user capable to control the level of the irradiance supply to the hydroponic plant in the Urban Kit system. All the installation specification is shown in Figure 3.18.

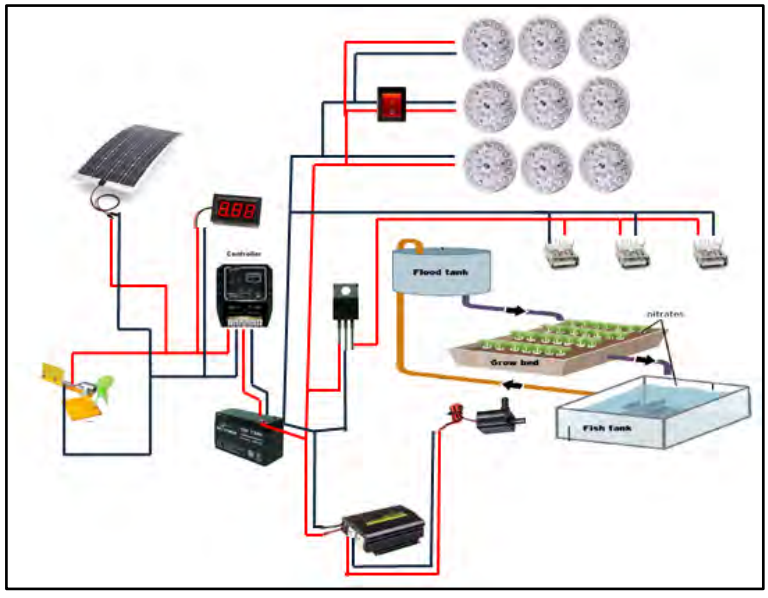


Figure 3.18: Diagram of standalone system

The complete model of standalone Urban Kit system that powered by renewable energy is shows in Figure 3.19. The model is completely running using the system and data able to collect.

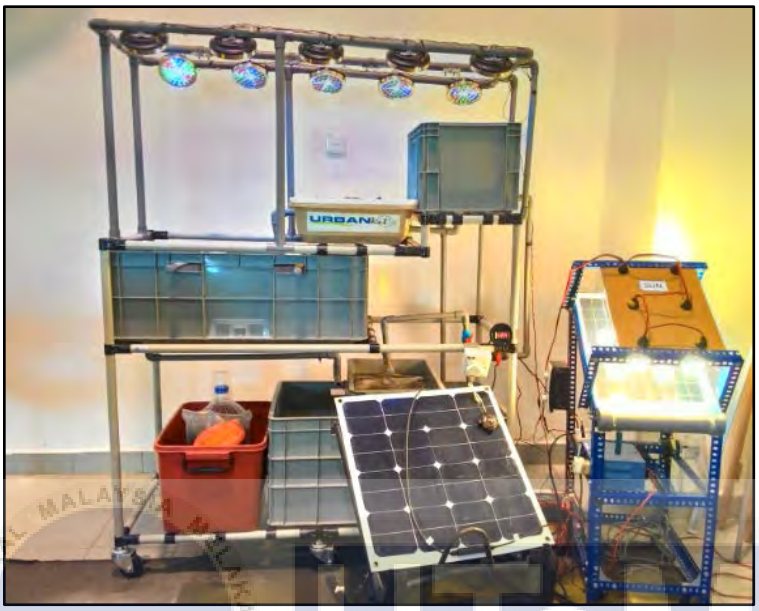


Figure 3.19: The complete model of standalone Urban Kit system

3.12Method of Data Collection

After finish all the installation on the Urban Kit system, the result will be taken according to the template table that shown below. The experiment will be separate in four part that is experimental of voltage generate by the flexible solar panel, experimental of voltage generate by the wind turbine, experimental of voltage generate by the both of the renewable energy system, and the experimental for level of irradiance supply for LED disk light. The data collected is following the template Table 3.1: Experimental of voltage generate by the flexible solar panel, Table 3.2: Experimental of voltage generate by the wind turbine, Table 3.3: Experimental of voltage generate by the both of the renewable energysystem, Table 3.4: Experimental for level of irradiance supply for LED disk light in APPENDICES B

3.13 Project Gantt chart And Key Milestones

3.13.1 Gantt Chart

Table 3.5: Gantt chart Shown in APPENDICES A3

3.13.2 Key Milestone

Table 3.6: Key milestoneShown in APPENDICES A4

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

In this chapter, the result is received from the experiments result that has been state in specifically. Then, this chapter is divided into five sections that are the calculation and the capability to be standalone, experimental result for the stand alone system of the Urban Kit and the reading of irradiance and light intensity (LUX) for the LEDdisk light for the irradiance supply for the hydroponic in the Urban Kit system.

4.2 The Calculation and the Capability to Be Standalone

The standalone system is calculate by the formula that can verify the number of battery and number of solar modules that can be used to support standalone Urban Kit system. The battery information is $V_{battery}$is 12V with 36Ah capacity, 60% depth of discharge with five days period of storage. For the flexible solar panel information, the $V_{panel}$is 12V and the charging efficiency is 21.5%. The information of the equipment is shown in Table 4.1 and the calculation to determine the number of module and battery is shown below.

Table 4.1: Power required by the equipment

Equipment	Power (W)	Time operate (h)	Wh/day	Current (A)
Water pump	60 W	24	1440	0.25
LED high	10 W	12	120	0.833
LED low	5W	12	60	0.2
Arduino sensor	1W	24	24	0.417
Total	76		1.644KWh/day	1.7

$$Min\ number\ of\ battery\ need = \frac{Total\ \ capacity\ \ need\ (Ah) \times 100\%}{Full\ \ capacity\ \ of\ \ Battery\ \ \times Depth\ of\ \ Discharge\ (\%)} \quad (4.1)$$

$$Total\ capacity\ need(Ah) = \frac{total\ \ usable\ (Wh) \times 5\ days}{12\ V} \quad (4.2)$$

$$Min\ number\ of\ battery\ need = \frac{\frac{1.644\ KW\ h}{day} \times 5\ days}{\frac{12\ V}{36Ah\ \times 60\%}} \times 100\%$$

$$= 31.2\ \text{Battery} \approx 32\ Battery$$

$$Min\ number\ of\ module\ need = \frac{daily\ \ electrical\ \ output\ \left(\frac{KW\ h}{day}\right) \times 100\%}{Daily\ \ output\ \ module\ \left(\frac{KW\ h}{day}\right) \times charging\ \ efficiency\ \ (\%)} \quad (4.3)$$

$$Min\ number\ of\ module\ need = \frac{1.644(\frac{KWh}{day}) \times 100\%}{1.7A \times 4.6\frac{h}{day} \times 12V\ KWh/day \times 21.5\ \%}$$

$$= 81.4\ \approx 82\ modulesneed\ (parallel)$$

Therefore, from the calculation the number of battery and flexible solar needed is around 82 module and 32 battery with 36Ah capacity**.** The number of flexible solar module needed is 82 because the flexible solar panel that use in the system is only 50W the power rating. Then, to support the standalone Urban Kit system it needs bigger rating of solar panel that can minimize the number of module needed and the battery rating also need to used greater capacity to reduce number of battery use.

Then, other technique that has been used to calculate and design the standalone system is using standalone online calculator. Standalone online calculator is the application that used to design standalone system. By using this application, all the information and requirement for the standalone system will be shows and suggested for the given information of Urban Kit system. The given information of equipment need is more efficient. Figure 4.1 and Figure 4.2 is show the result of the Standalone online calculator.

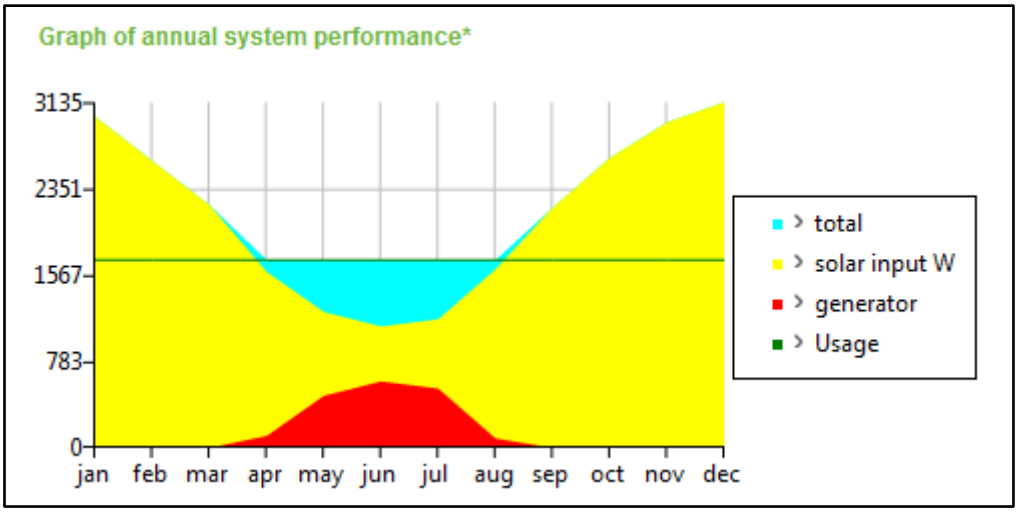


Figure 4.1: Data from standalone online calculator

System voltage	24 V
Current required (factoring loss)	83 Ah at 24 V
Solar Panels	4 × Solarfun 175Watt 24Volt Solar Module
Solar Charge Controller	1 × Morningstar Sunsaver 20, 24Volt 20Amp Regulator with LVD
Inverter	1 × Latronics Sinewave Inverter 600Watt 24Volt
Days of battery backup	5 days
Battery depth of discharge	50 %
Battery bank required (factoring loss)	833 Ah 8 × Trojan Flooded Lead Acid Battery 6V 420Ah

Figure 4.2: All the required equipment needs

4.3 Experimental Result for Flexible Solar Panel

For the experimental result of flexible solar panel is collect the data from the flexible solar panel place under the sun for 12 hour that is from 7.00am to 7.00pm on 11th April 2016. This is because normally sun start to shine at that time. So, the light from the sun will make the flexible solar panel to generate electricity. The reading is taking on the field to maximize the exposing area of flexible solar panel to the sun light beam. Besides that the effectiveness of the flexible solar panel to generate electricity is depending on the weather of environment. If the day is rainy, the electricity generate will be low or nothing. Therefore, in normal day the solar panel will generate electricity at rated value. The Table 4.2 below will show the result of the voltage generate by the flexible solar panel.

.Table 4.2: Result for voltage generate by flexible solar panel 11th April 2016

Time/hour	Voltage generate by flexible solar panel, V_{solar}	Output voltage from charge controller to battery, V_{output}	Voltage of battery, $V_{battery}$
0700	4.33	2.30	12
0800	9.62	9.30	12
0900	14.34	14.22	12
1000	17.57	17.33	12
1100	19.68	19.50	12
1200	20.11	20.00	12
1300	21.45	21.52	12
1400	23.67	23.67	12
1500	24.25	24.25	12
1600	23.22	23.20	12
1700	22.56	22.45	12
1800	17.88	17.32	12
1900	11.56	11.67	12

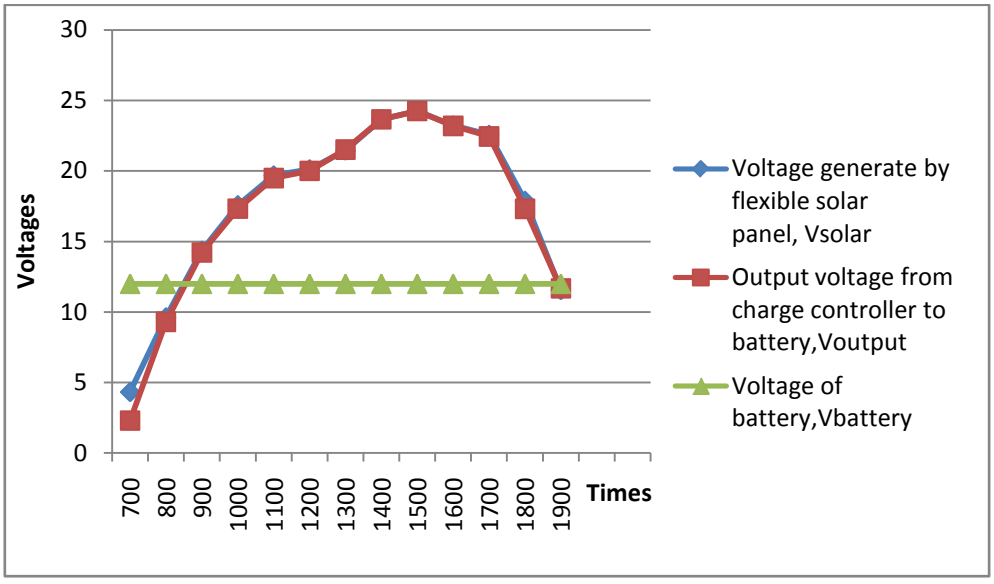


Figure 4.3: Graph of voltage generate by flexible solar panel on 11th April 2016

From the Figure 4.3 above, the analysis that able to make from the graph is the high level of sun are gives positive effect for the power generation using flexible solar panels. The higher voltage generate is between times from 2.00pm to 5.00pm. This is because, the sun supply full capacity of irradiance and solar beam to the flexible solar panels. But, in certain cases the solar panel will drop of the voltage generation because of the heat of the sun. The solar panel has a limit that can the solar panel withstand for the extreme heat condition that depends on the PV curve of the solar panels. The PV curve will show the characteristic of the electricity generation against the heat or solar panel temperatures that shows in Figure 4.4 below.

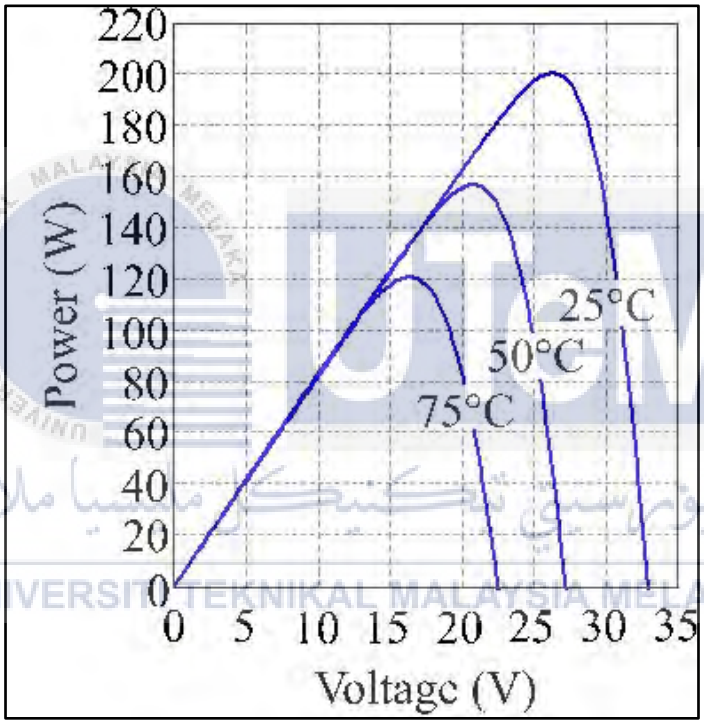


Figure 4.4: PV curve on temperature different

4.4 Experimental Result for Wind Turbine

Wind turbine generally can generate electricity when the winds go through the turbine blade and rotate the turbine shaft. Then, for this experiment the generator use is DC motor high torque single phase type. Theoretically, the generator will produce electricity with 12V at 15600rpm. But, in a real world the generator will not give that output because of many factors like wind speed, friction, fan blade design, condition of the motor, and others factors. Fromthe

previous chapter notice that most of the generator use three phase AC motor for the wind turbine generator. So that, the electricity output for three phase AC motor generator is high compare with the DC motor generator. Other than that, to generate electricity using wind turbine the biggest aspect is wind speed that will influence the energy generate by the wind turbine. So, this kind of renewable energy also is depends on the condition of the weather. Other than that, the other factor is the place that proceed the test is not suitable for generate electricity using wind turbine. For the data collecting, the method used is replace the variable of wind with table fan that will supply the constant wind speed and able to variable level of wind speed. For measuring current, the bulb with 3Watt is used. The result is stated in Table 4.3 below.

Table 4.3: Result for voltage generate by wind turbine

Speed level	Wind speed, (m/s)	Voltage generate, $V_{wind,}$ (V)	Current produce, I_{wind}(A)
0	0	0	0
1	10	1.79	0.05
2	14	2.0	0.05
3	16	2.26	0.06

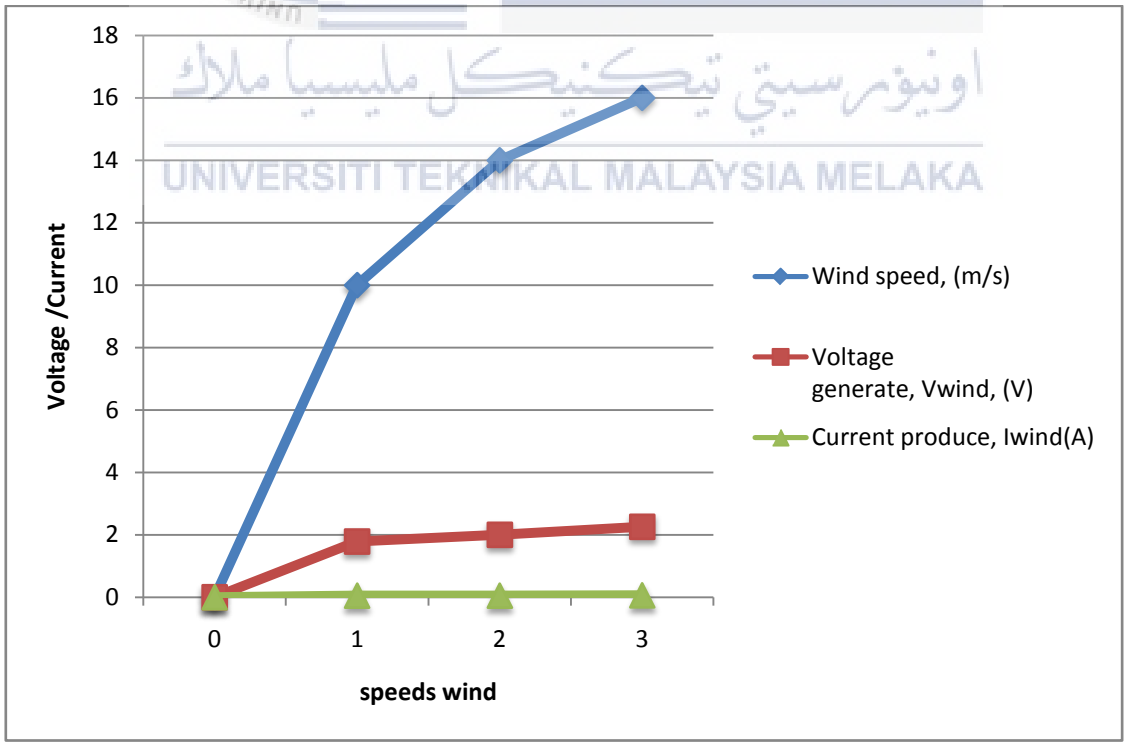


Figure 4.5: Graph of voltage generate by wind turbine

From the Figure 4.5 above, the generation of electricity is depends on the speed of wind. The faster the wind produce, the higher the electricity generates. The function of the wind turbine also is same as the solar panels. The electricity that generate will store in the battery through charger controller to avoid the battery become supply to the DC motor. But, there has a weakness of wind turbine that was informed before. The location for the testing is not suitable. So that, only certain place can use wind turbine for the generation for the Urban Kit other than that flexible solar panels will take an action for generation power purpose.

4.5 Experimental Result for Both of Flexible Solar Panel and Wind Turbine

For the combination of both electricity supply from generator wind turbine and flexible solar panel, the voltage supply to the system is unpredictable because certain condition that related by the nature. Besides that, the output voltage that store to the battery is constant with 12V and the Urban Kit system also will be receives 12V from the battery. In theoretically, the voltage will get higher when the supply from the solar panel and wind turbine generator is plant it together. Then, the result also will be fluctuated for the $V_{solar/wind}$ and V_{output} for the charge controller. The result is shown in Table 4.4 below.

Table 4.4: Result for both renewable energy generate

Time/hour	Voltage generate by flexible solar panel and wind turbine, $V_{solar/wind}$	Output voltage from charge controller to battery, V_{output}	Voltage of battery, $V_{battery}$
0700	4.22	0	12
0800	8.48	8.30	12
0900	13.67	13.56	12
1000	17.45	17.40	12
1100	18.79	18.67	12
1200	20.45	20.57	12
1300	22.87	22.83	12
1400	23.45	23.43	12
1500	23.12	23.09	12

1600	24.56	24.58	12
1700	24.67	24.54	12
1800	18.53	18.45	12
1900	17.49	17.50	12

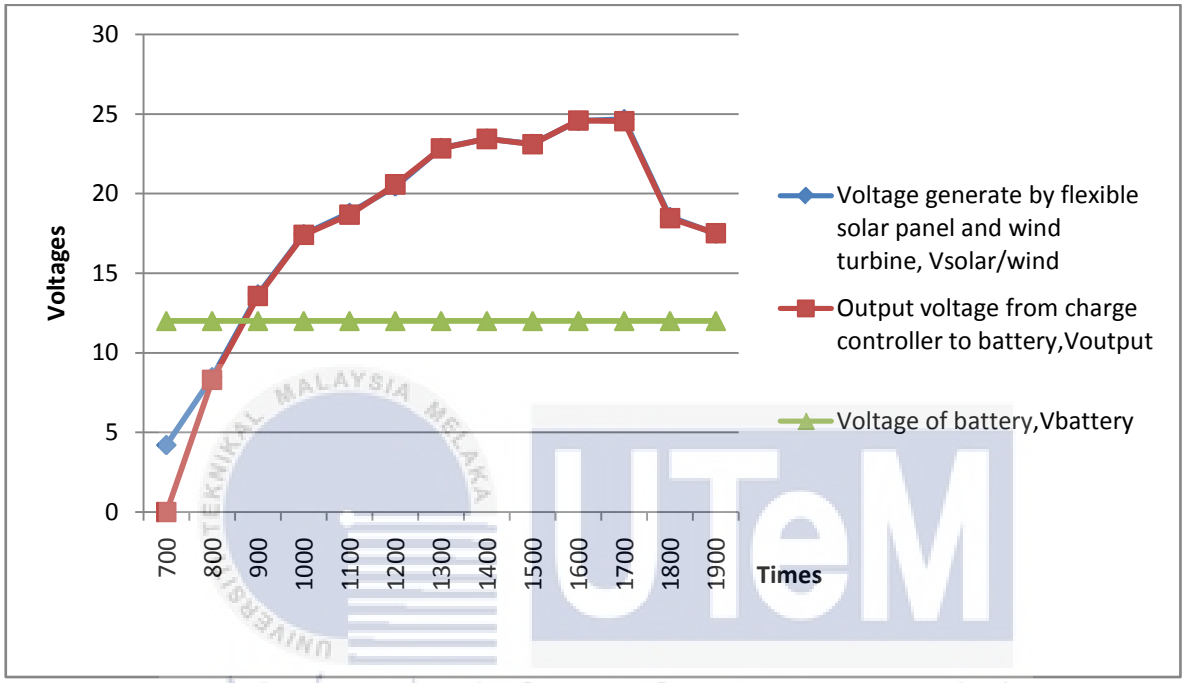


Figure 4.6: Graph for Both of Flexible Solar Panel and Wind Turbine

Therefore, from the Table 4.4 and Figure 4.6 above the analysis able to make is the electricity generates from the flexible solar panels and wind turbine is able support and charging the battery that using by the Urban Kit system for 24 hour. The standalone system that was design is able to support all the operation in the Urban Kit system that is contain of water pump, LED disk light, and several sensor for monitoring the Urban Kit system.

4.6 Experimental Result for Level of Irradiance Supply for LEDDiskLight

The supply of irradiance for the hydroponic plant in the Urban Kit system is supply by the LED disk light. The LED disk light can generate irradiance like growth light that used in an industrial of agriculture. Generally, every green plant need sun light to life. The sun light will supply irradiance to the plant that can help plant to do photosynthesis process. So that,

the irradiance level of the LED disk light will be measured in two conditions that is at high irradiance level and low irradiance level. The colour of spectrum needed for growing process vegetable/plant mostly is full spectrum that consists of white light, red light, blue light, green light and ultraviolet light [13]. The irradiance level can be controlled by the user, user can turn ON and OFF the LED disk light depends the plant and environment conditions. The experiments is using LUX meter to measure the brightness of the light intensity of the LED disk light. The result is show below in Table 4.5 and Table 4.6. Figure 4.7 show the location of the measure takes.

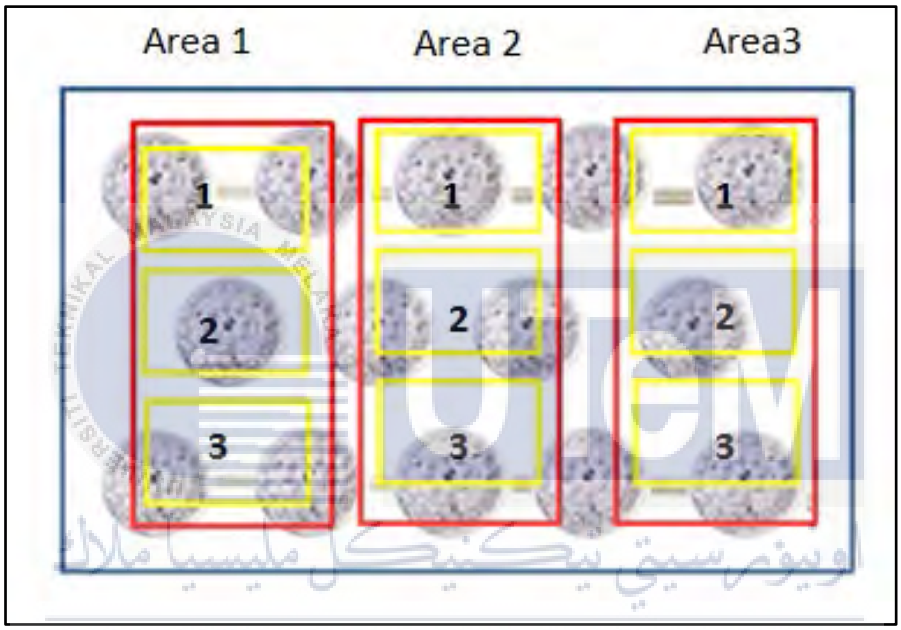


Figure 4.7: Area that measure for the Light Intensity in (LUX)

Table 4.5: Result for Low light intensity

Area Position	Reading of light intensity measure in LUX		
	1	2	3
Position 1	161	279	341
Position 2	229	293	398
Position 3	137	187	237

Table 4.6: Result for High light intensity

Area Position	Reading of light intensity measure in LUX		
	1	2	3
Position 1	678	595	784
Position 2	1015	974	957
Position 3	582	429	814

Generally plant or vegetable need is around eight hours of irradiance supply in an outdoor condition to grow. But, in the indoor condition the important thing to monitor is the temperature of the surrounding of the Urban Kit System. To avoid from the problem of over heat or cold condition, the solution was control the brightness of the LED disk light. If need to more heat or irradiance supply user just turn on the LED light at high level of irradiance and if need to cool down the surrounding of the Urban Kit System and plant user just turn off the high level and let it to the low level of irradiance. The condition of high level and low level of irradiance supply can refer on appendix C5 and appendix C6.So, the suggestion for Urban Kit System is need to keep the LED disk light at high level around 12 hours and let the LEDdisk light at low level 12 hours.

4.7Summary of Result and Discussion

At the end of experiment, the discussion that can make is the location of applied the testing for Renewable Energy Powered and Monitoring for Urbankit System is not suitable for wind turbines because the wing is unable to generate and operate the turbine. Besides that, the most renewable energy generate by flexible solar panel applied in the system. During the experiments, the table fan is used to moving up the turbine and generates the constant energy output for the wind turbine. The combination of constant energy output from wind turbine and flexible solar panel generate an energy that will supply and store to the battery. The energy store to the battery will supply the electricity to support Urbankit system without relying any other supply from grid.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Introduction

This section is briefly explained about the conclusion of the project of renewable energy powered and monitoring for Urban Kit system.

5.2 Conclusion

For this project, all the action in order to build standalone system that support Urban Kit system was done it properly. In action to complete the objective of the renewable energy powered and monitoring for Urban Kit system is already build up the standalone system. This is because the Urban Kit system will fully operate by using supply from the standalone system using wind turbine generator and flexible solar panel. But in this case, the wind turbine is not properly operated because of the condition and area is not suitable for wind turbine. Besides that, in this project the flexible solar panel that has been use only has rating of 50W for a single module. But, in this case the Urban Kit system power usage operates about 1.644KWh/ day for the system operate in 24 hours. So that, the number of the flexible solar panel needed at least 82 module flexible solar panels needed to support the standalone system. Besides that, the number of battery needs to support the system according the calculation is 32 units of battery with 36Ah capacity. So, the battery needs a higher capacity rating to minimize the number of battery needs. Other than that, the Urban Kit system is also capable to monitor the voltage to observe any problem happen to the flexible solar panel and wind turbine. The method to observe the performance is using mini voltmeter that attach to the input of charger controller. All the steps are following the plan of objective that state in chapter 1. Besides that, the objective of to supply and control level of irradiance to the hydroponic plant in Urban Kit system also was install with use LED disk light and switch to control the level of the intensity supply to the hydroponic plant. As the conclusion, the objectives of renewable energy powered and monitoring for Urban Kit system is done properly for the design hybrid renewable energy system using wind turbine and flexible solar panel in supporting the Urban

Kit system, monitoring the supply voltage from the renewable energy system to the Urban Kit and to control the level of irradiance to the plant/ vegetable in UrbanKit

5.3 Recommendation

For the recommendation of this project of the standalone system for Urban Kit is need to replace wind turbine with other type of renewable energy that suitable with the location. This is because during the testing for data collection the wind turbine that was installed cannot work properly because the testing place not suitable to generate energy from wind around that place. The suggestion for the best renewable energy that can be used is flexible solar panel because Malaysia is located at equator that always has about 12 hours of day light and 12 hours night and also the peak sun hour is about 4.6 hour per day. Then, for an action to build efficient system of renewable energy powered and monitoring for Urban Kit system, the design system and equipment must replace with other rating of solar panel and battery that has higher capacity to reduce the number and also the cost of the system to build up the system. Besides that, timing for supply the irradiance that get from the LED disk light also need to be upgrade with place the automatic system In chapter 4, the calculation using standalone solar online calculator is show the required standalone equipment in Figure 4.2. Therefore, all the equipment shown in the Figure 4.2 is more effective than the equipment uses in the standalone Urban Kit system. This means, from the analysis in chapter 4, the best way to generate electricity is use only solar panels for support the whole system of Urban Kit.

REFERENCES

[1] A. Kusiak, Z. Zhang, and A. Verma, *Prediction, operations, and condition monitoring in wind energy*,*Energy*, vol. 60, pp. 1–12, 2013.

[2] AS. Wind turbine technology*: fundamental concepts of wind turbine engineering. New York*: ASME; 1994.

[3] A. Kusiak, H.-Y. Zheng, and Z. Song, *On-line Monitoring of Power Curves, Renewable Energy*, Vol. 34, No. 6, 2009, pp. 1487-1493.

[4] S. Gmbh, D. Str, and D. B. B. Germany, *Thin Flexible Solar Panels - Thin Film Electronics PowerFilm Solar - Thin Flexible Solar Panels*, 2007.

[5] Weixiang, S., Bin, A.S.K., & Seng, O.K (2005). *A study on Standalone Photovoltaic System with Real Meteorological Data at Malaysia*. *IEEE Xploree*, 937 – 941.

.

[6] I. Daut, M. Irwanto, Y. M. Irwan, N. Gomesh, Rosnazri, and N. S. Ahmad, *Potential of solar radiation and wind speed for photovoltaic and wind power hybrid generation in Perlis, Northern Malaysia*,*2011 5th Int. Power Eng. Optim. Conf. PEOCO 2011 - Progr. Abstr.*, no. June, pp. 148–153, 2011.

[7] A.W. Dahmouni, M.B. Salah, F. Askri, C. Kerkeni, S.B. Nasrallah, Wind energy in the Gulf of Tunis, Tunisia, *Renewable and Sustainable Energy Reviews* , vol.14, pp. 1303-1311, 2010.

[8] U. Aynur, B. Figen, Assesment of wind power potential for turbine installation in coastal areas of Turkey, *Renewable and SustainableEnergy Reviews*, vol.14:, pp. 1901-1912, 2010.

[9] M. N. M. Nasir, N. Z. Saharuddin, M. F. Sulaima, M. H. Jali, W. M. Bukhari, Z. H. Bohari, and M. S. Yahaya, *Performance evaluation of stand alone hybrid PV-wind generator,* vol. 070040, no. May, p. 070040, 2015.

[10] M. L. Madden, *The effect of irradiance on the short-term growth rates of two strains of Griffithsia pacifica Kylin*, vol. 0079, no. 410, pp. 1–27, 2012.

[11] D. a Maclennan, B. P. Turner, J. T. Dolan, M. G. Ury, and P. Gustafson, *International Lighting in Controlled Environments Workshop,Growth (Lakeland)*, no. 1937, pp. 1–8, 2008.

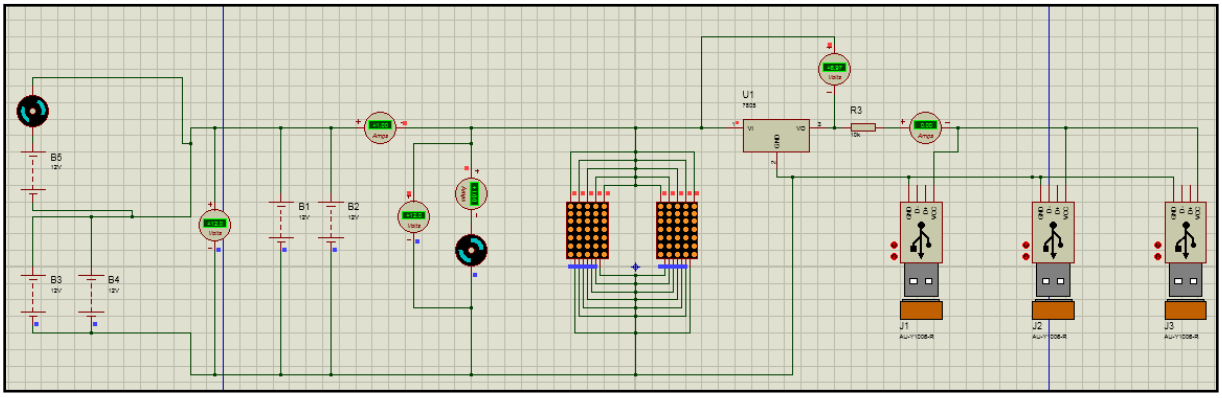
[12] Mathias Aarre Maehlum **:** Which Solar Panel Type is Best? Mono- vs. Polycrystalline vs. Thin Film(May 3,2013), Energy InformativeThe homeowner`s guide to solar panels Web site. Retrieved November 13,2012, from http://energyinformative.org/bet-solar-panel-monocrystalline-polycrystalline-thin-film/s

[13] T. Top, L. E. D. Grow, L. For, and T. Money, *Best LED Grow Lights Reviews For 2016 The Top 6 LED Grow Lights For The Money*,2016.

APPENDICES A

APPENDICES A1

ISIS Proteus Simulation



APPENDICES A2

Design system using standalone solar online calculator

APPENDICES A3

Table 3.5: Gantt chart

Tasks	2015															2016																							
	September			October				November				December				January				February				Mac				April				Mei				June		
Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	16	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Search/Register for Supervisor and Project Title																																						
Research about the previous project that be related																																						
Literature Review																																						
Ready PSM I Report																																						
Design the circuit and the system																																						
List and buy the equipment need																																						
Send PSM I Report																																						
Seminar and Alter of Commented Report																																						
Design and modified the hardware																																						
Send alter PSM I Report																																						
Installation equipment to system																																						
Experiment																																						
Collecting Data																																						
Ready PSM II Report																																						
Send PSM II Report																																						
Seminar and Alter of Commented Report																																						
Send Final Report																																						

APPENDICES A4

Table 3.6: Key milestone

Project Movement	Period
Assortment of Article and Literature Review	14 September 2015-30 September 2015
Research related project involved	1 October 2015-8 October 2015
Research on the early set up of solar panel and wind turbine	15 October 2015- 2 November 2015
Design prototype	3 November 2015 – 18 November 2016
Prepare PSM I Report	6 November 2015
Send PSM I Report	4 December 2015
First seminar	15 December 2015
Construct design for Urban Kit	20 December 2015 – 4March 2016
Prepare final report	13 April 2016-23 May 2016
Final seminar	30 May 2016- 3 June 2016
Send final report	7 June 2016

APPENDICES B

APPENDICES B1

Table 3.1: Experimental of voltage generate by the flexible solar panel

Time/hour	Voltage generate by flexible solar panel, V_{solar}	Output voltage from charge controller to battery, V_{output}	Voltage of battery, $V_{battery}$
0700			
0800			
0900			
1000			
1100			
1200			
1300			
1400			
1500			
1600			
1700			
1800			
1900			

APPENDICES B2

Table 3.2: Experimental of voltage generate by the wind turbine

Speed level	Wind speed, (m/s)	Voltage generate, V_{wind}	Current produce, I_{wind}
0			
1			
2			
3			

APPENDICES B3

Table 3.3: Experimental of voltage generate by the both of the renewable energy system

Time/hour	Voltage generate by flexible solar panel and wind turbine, $V_{solar/wind}$	Output voltage from charge controller to battery, V_{output}	Voltage of battery, $V_{battery}$
0700			
0800			
0900			
1000			
1100			
1200			
1300			
1400			
1500			
1600			
1700			
1800			
1900			

APPENDICES B4

Table 3.4: Experimental for Low light intensity

Test Area	Reading of light intensity measure in LUX		
	1	2	3
Position 1			
Position 2			
Position 3			

Table 3.5: Experimental for High light intensity

Test Area	Reading of light intensity measure in LUX		
	1	2	3
Position 1			
Position 2			
Position 3			

APPENDICES C

APPENDICES C1

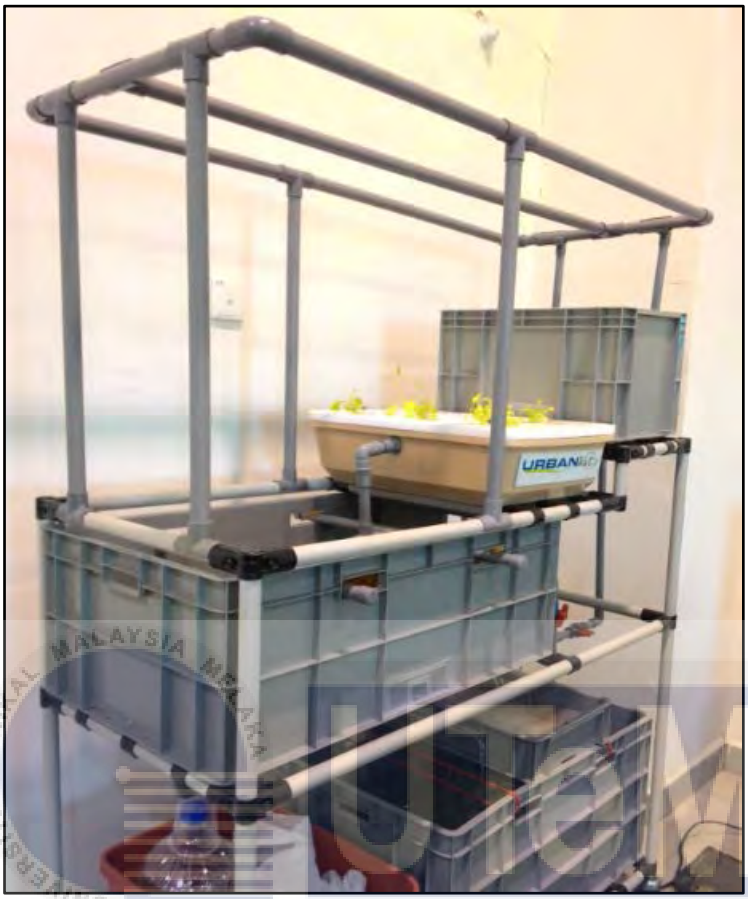
Original Urban Kit receive from supplier (MARDI)

APPENDICES C2

Progress in modified Urban Kit system

APPENDICES C3

Installing the roof light for Urban Kit

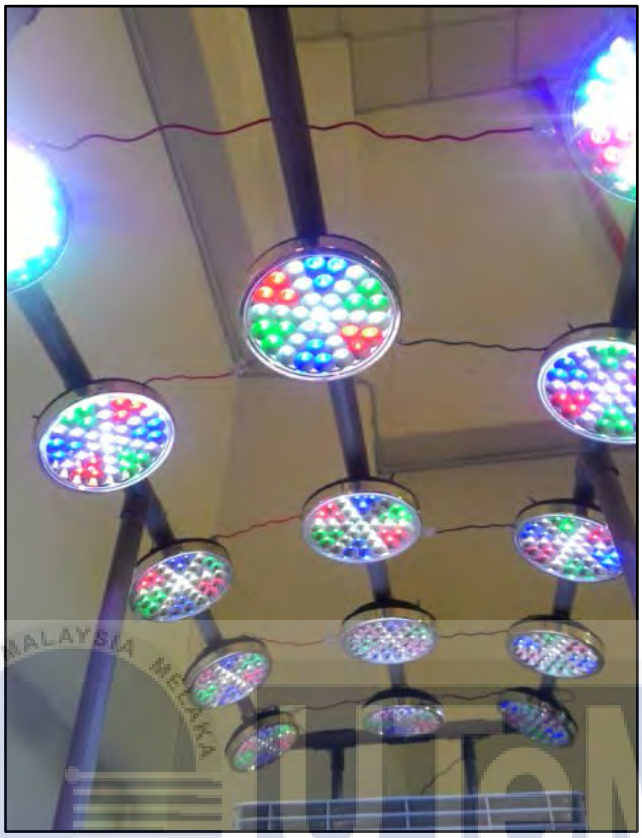


APPENDICES C4

Installing LED disk light to the Urban Kit roof

APPENDICES C5

During high level irradiance supply

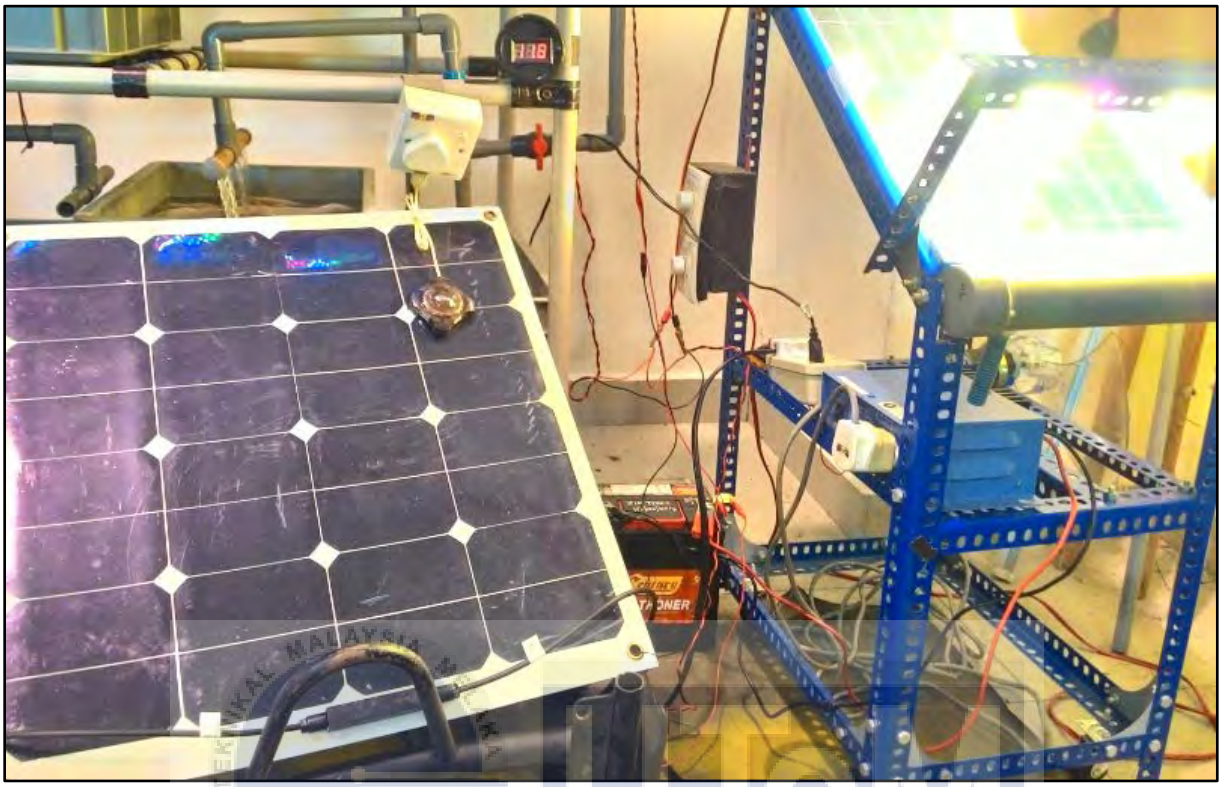


APPENDICES C6

During low level irradiance supply

APPENDICES C7

Install and functionality test of the equipment that installed



APPENDICES C8

The experiments plant grow by using LED disk light

APPENDICES C9

Complete model for Renewable Energy Powered and Monitoring for Urban Kit System