SOLAR POWERED IRRIGATION

MAIMUNAH AWANG MAJID

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"I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power)"

Signature :……

Supervisor's Name : EN. ALIAS BIN KHAMIS

Date :…….

"I hereby declared that this report is of my own work except for the excerpts that have been cited clearly in the references"

Signature :……..

Name : MAIMUNAH BINTI AWANG MAJID

Date :……..**.....**

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ABSTRACT

The main purpose of this project is to design and develop solar powered irrigation. This project combines the knowledge of electrical and electronic. Solar pump are used on small gardens, farms, and orchards to pump the water to irrigate the plants. It is most economical to pump the water to irrigate the gardens using solar power. Solar powered irrigation can be used to handle of power functions for 12 volts water pump. Solar panel will produce direct current supply and if an alternating current is used, the direct current need to convert to alternating current using an inverter. An irrigation process must be done during the early morning and evening where the sunshine is not at peak power. So, the system needs some restore energy to power up the water pump. The restore energy is back-up energy from the deep cycle battery. It's useless if we need to switch on the pump manually, so the timer is installed to irrigate the garden automatically at the same time everyday. A tank is used to store the rain water runoff from roof. The water pump will pump the water from the tank to porous pipe to irrigate the garden.

ABSTRAK

Tujuan utama projek ialah untuk mereka dan membangunkan penyiraman menggunakan solar. Projek ini menggabungkan pengetahuan elektrik dan elektronik. Pam solar biasanya digunakan di kebun kecil, taman dan sebagainya untuk mengepam air untuk menyiram tanaman menggunakan kuasa solar. Penyiraman berkuasa solar ini boleh digunakan untuk kegunaan pam air yang berkuasa 12V. Solar panel akan menghasilkan bekalan arus terus dan jika alatan yang digunakan memerlukan bekalan arus ulang-alik, arus terus akan diubah kepada arus ulang-alik dengan menggunakan penukar voltan. Proses penyiraman ini mesti dijalankan pada sebelah pagi dan petang di mana kuasa solar tiada untuk menghasilkan tenaga. Jadi, sistem ini memerlukan tempat penyimpanan tenaga, tenaga di simpan di dalam bateri yang boleh dicas semula. Ianya agak kurang praktikal untuk sistem tersebut dijalan secara manual, jadi pemasa dipasang untuk menyiram tanaman secara tetap dan tanpa penyeliaan setiap hari. Tangki akan digunakan untuk meyimpan air untuk menyiram tanaman. Air dari tangki akan digunakan untuk menyiram tanaman dengan menggunakan saliran paip kecil yang diletakkan di atas permukaan tanah.

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LIST OF ABBREVIATIONS

AC	-	Alternating Current
DC	-	Direct Current
PV	-	Photovoltaic
TNB	-	Tenaga Nasional Berhad
EVA	-	Ethylene vinyl acetate
UPS	-	Uninterruptible power supply
BJT	-	Bipolar junction transistors
FET	-	Field-effect transistors
CCA	-	Cold cranking ability
AH	-	Ampere hours

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CHAPTER 1

INTRODUCTION

1.1 Introduction To Solar

Solar power is absolutely perfect for use with irrigation systems for gardens, allotments, greenhouses and polytunnels. When the sun is shining you need more water and so the solar power is there for the pump. By adding a suitable deep-cycle battery, power can be made available 24 hours per day enabling watering in the evening which is the best time to water plants in the summer so that the water has a chance to soak into the ground. A main water tank is used to store rainwater runoff from roofs and grey water from where it is pumped to a secondary tank when and where it is needed. The secondary tank can be placed at ground level and used to fill watering cans or in a slightly elevated position to gravity feed water through porous pipe or leaky pipe irrigation.

A typical solar irrigation system is made up of the following components:

- PV Solar Panel
- Deep cycle battery
- 12V Pump
- Tubing to carry the water

An automated irrigation system can be put together using a suitable 12V programmable timer or mechanical timer which will turn on the pump at the same time every morning and evening. The timer will turn on or off the circuit each day. To protect the pump from being damaged if it runs out of water to pump and to prevent any secondary tanks from overflowing, float switches can be used to detect water levels and their readings fed into the electronic controller. The solar powered irrigation is illustrated as shown in figure below.

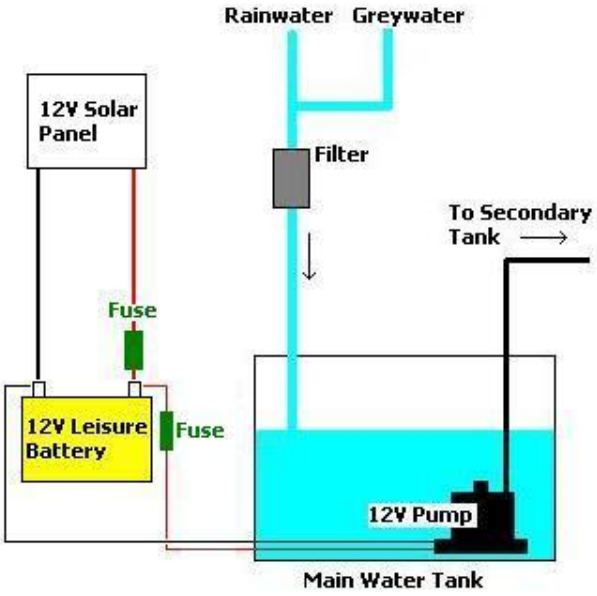

Figure 1.1: Solar Power Irrigation

1.2 Problem Statement

Nowadays, most of the power contributes the pollution to the environment. So, this project is developed to generate free energy from the sun which is non-polluting to the environment and to replace the others irrigation process which is the farmers used the water pump that is powered by petrol or TNB supply. This will make the irrigation process easily and consistently. Besides, by using solar energy it can save energy, time and money where there is no need to pay a bill and just to pay for the payment of installation and it will be personal utilities.

1.3 Objective

There are many main objective of doing this project. The main purpose of this project is to design and develop solar powered water pump combines the knowledge of electrical and electronic which is replaced the other technique to irrigate garden with the efficient and consistent equipment. The main objectives of this project are:

- To design the water pump powered by solar circuit, inverter and DC supply.
- To develop the circuit of the solar power irrigation.
- To simulate the circuit by using the proteus and multisim software.
- To test the circuit by using portable stand alone solar panel at energy efficiency lab.
- To provide a back-up power when the power from the solar is not available by using deep-cycle battery.

1.4 Scope

The scope of my project is to irrigate the mini farm having an area of 5 m^2. The maximum of the current that will be use by load is 1 ampere. It consists of designing the DC part and AC part to provide the AC input to the load. The function of this solar powered irrigation is to irrigate the mini garden using solar energy. This project is developed to be used in farm, garden and other place for irrigation process. This solar power irrigation are also develops in small size and output so that it will be portable.

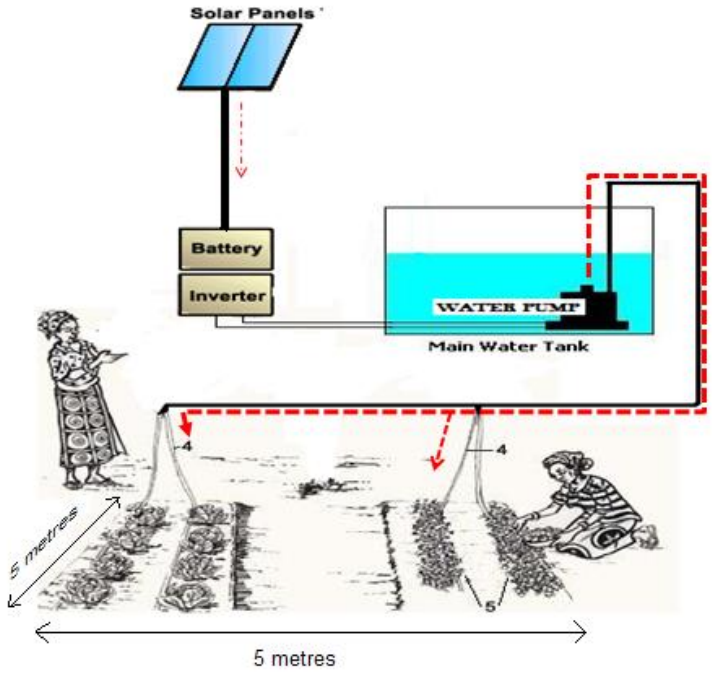

Figure 1.2: The Area That Covered By Solar Powered Irrigation

1.5 Project Background

Solar powered irrigation is an idea to irrigate the small garden or farm by using solar which is free energy with no polluting and environmental friendly. Solar panel produces electricity to operate the charge controller and charging the battery. The solar charge controller circuit is used to prevent the battery from overcharging and effects the battery life time. The battery is used to store the electricity to power up the water pump during the sunlight is not necessary to produce the electricity. In order to be able to use solar to operate the appliances in your home, an inverter will convert PV power from DC to AC. Inverters can be further classified as units that use batteries. The output of the system is AC water pump that will pump up the water to irrigate the small farm. The input of the water pump is about 0.75 ampere current rating and 240VAC input voltage to operate. The full illustration for this project is shown in figure 1.1 is under the scope description.

CHAPTER 2

LITERATURE REVIEW

This chapter is consists of explanation and review of past projects that have been done before. It is consists of the products in the market and in industrial field. Beside that, this chapter also consists about the theory of component, equipment and energy that is used in this project.

2.1 Solar

Electricity generated by solar panels is referred to as photovoltaic. The photovoltaic produces electricity directly from sunlight with a solar panel made of semiconductor material. The power provided is direct current. The basic building block is known as a cell. Many cells put together are known as a module and many modules assembled together from an array. A PV system will consist of an array of modules generating DC electricity, an inverter and sometimes battery storage back-up with charge controller. [4]

A photovoltaic cell consists of two or more thin layers of semiconducting material, most commonly silicon. When the silicon is exposed to sunlight, electrical charges are

generated and this can be conducted away by metal contacts as direct current. The electrical output from a single cell is small, so multiple cells are connected together and formed to modules.

There are two kinds of electricity, DC and AC. Homes that are connected to utility power using AC electricity. Flashlights, small radios and automobiles use direct current electricity. In order to be able to use solar to operate the appliances in home, an inverter will convert PV power from DC to AC. Inverters can be further classified as units that use batteries. The amount of power produced will depend upon how large the system.

Types of solar:

- Solar power system
- Solar electric system
- Renewable solar energy
- Renewable electricity

Benefits of renewable solar energy:

- Renewable solar energy does not deplete earth's natural resources.
- Renewable solar energy is dependable, affordable and easy to distribute, simple to connect to existing electrical grids.
- Renewable solar energy allows lock-in long term electricity rates, putting in control even if on-grid utility prices solar.
- Solar systems are reliable, attractive and affordable.

Advantages of photovoltaic solar power

Photovoltaic solar power is one of the most promising renewable energy sources in the world. Compared to non-renewable sources such as coal, gas, oil, and nuclear, the advantages are clear:

- Generates free energy from the sun.
- Have no moving parts to break down thus requiring minimal maintenance.
- Non-polluting energy reduces emissions, has no direct impact on the environment.

- Photovoltaic cells are modular
- Systems have a long life and durability, the cells life time is about 25 to 35 years.
- Grid tie systems allowing selling excess electricity back to the utilities.
- Can be installed and operated anywhere including areas of difficult access and remote locations.
- Helps from dependence on foreign oil.
- PV cells make no noise and give off no exhaust.
- Allow the use of electricity in remote areas where it would be expensive or impossible to run power lines.
- Have electrical power during blackouts.

Solar energy is the radiant light and heat from the Sun that has been harnessed by humans since ancient times using a range of ever-evolving technologies. Solar radiation along with secondary solar resources such as wind and wave power, hydroelectricity and biomass account for most of the available renewable energy on Earth. Only a minuscule fraction of the available solar energy is used.

Solar power technologies provide electrical generation by means of heat engines or photovoltaic. Once converted its uses are only limited by human ingenuity. A partial list of solar applications includes space heating and cooling through solar architecture, portable water via distillation and disinfection, day lighting, hot water, thermal energy for cooking and high temperature process heat for industrial purposes.

Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute sunlight. Active solar techniques include the use of photovoltaic panels, solar thermal collectors, with electrical or mechanical equipment, to convert sunlight into useful outputs. Passive solar techniques include orienting a building to the sun, selecting materials with favorable thermal mass or light dispersing properties and designing spaces that naturally circulate air.

After doing literature review, there are many knowledge gains in order to finish this project. Other than that, it will show the differences of controlling method and components

that has been use. From the literature review, the analysis can be done for this solar powered irrigation.

A photovoltaic array is a linked collection of photovoltaic modules, which are in turn made of multiple interconnected solar cells. The cells convert solar energy into direct current electricity via the photovoltaic effect. The power that one module can produce is seldom enough to meet requirements of a home or a business, so the modules are linked together to form an array.

Most PV arrays use an inverter to convert the DC power produced by the modules into alternating current that can plug into the existing infrastructure to power lights, motors and other loads. The modules in a PV array are usually first connected in series to obtain the desired voltage, the individual strings are then connected in parallel to allow the system to produce more current. Solar arrays are typically measured by the peak electrical power they produce, in watts, kilowatts or even megawatts.

A solar electric panel, often called a PV panel is basically a set of treated silicon cells arranged in a series string that produces electric power when exposed to light. There are four common types of solar panels manufactured:

- Monocrystalline - made from a single large crystal, cut from ingots. Most efficient, but also the most expensive. Somewhat better in low light conditions, but not as good as some advertising hype.
- Polycrystalline - basically, cast blocks of silicon which may contain many small crystals. This is probably the most common type right now. Slightly less efficient than single crystal, but once set into a frame with 35 or so other cells, the actual difference in watts per square foot is not much.
- Amorphous - thin film silicon is spread directly on large plates, usually of something like stainless steel. Cheaper to produce, but often much less efficient, which means larger panels for the same power. Unisolar is the one example.
- Vaporware - the one that pops up in the news about every 2 months, proclaiming the next major breakthrough that will make plastic spray on solar cells that will cost around 5 cents a watt or some similar claim.

For all practical purposes, how the four types of solar work in applications are very similar. Its will all do the same thing which is make electricity when the sun hits it. Thin film solar panels are often less efficient, so it will take up more room for the same power, but on the other hand it's often cheaper per watt. Crystalline panels are almost always more efficient in converting sunlight to power, so take up less room. They are usually somewhat more expensive than amorphous panels, but often the installation costs will be less because much less hardware is required.

2.2 Types of Solar Electric Systems

2.2.1 Small Stand-Alone Systems

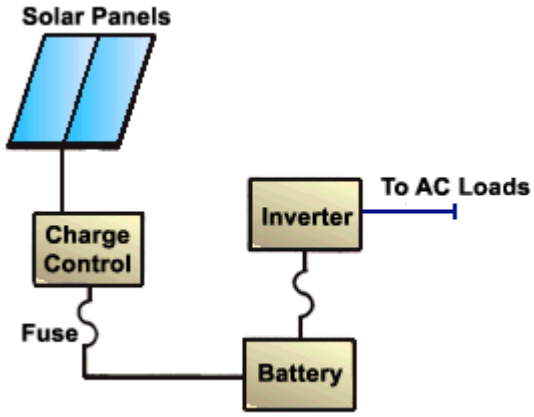

Figure 2.1: Small Stand Alone Systems

The small stand-alone system is an excellent system for providing electricity economically. These systems are used primarily for RV power, lighting, cabins, back-up and portable power systems. The size of the photovoltaic array and battery will depend upon individual power requirements. The solar panels charge the battery during daylight hours and the battery supplies power to the inverter as needed. The inverter convert the 12 volt batteries DC power into 240 volt AC power, which is the most useful type of current for most applications. The charge controller terminates the charging when the battery reaches full charge, to keep the batteries from gassing-out, which prolongs battery longevity.

2.2.2 Grid-tie Solar Systems

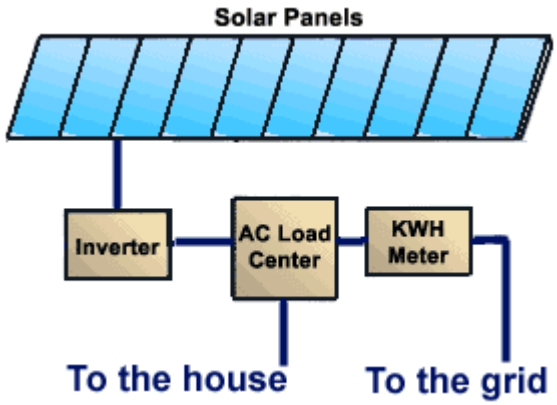

Figure 2.2: Grid-Tie Solar System

A Grid-tie solar system is useful for homes that are already connected to the utility grid. The advantage of this type of system is the price reduction of utility. The system has to be wired with an inverter that produces pure-sine-wave AC electricity, which is necessary for connecting to the utility grid. Another advantage to this type of system are the tax incentives and rebates available from different state and local agencies. Owning a grid-tied system in California qualifies you for the State Buydown program, drastically reducing the overall system cost. Most of these systems typically do not have the battery storage that allows for power when the utility fails. Grid-tie system can be installed with battery backup power to keep critical loads operating in the event of a power failure.

2.2.3 Complete Stand-Alone Solar System

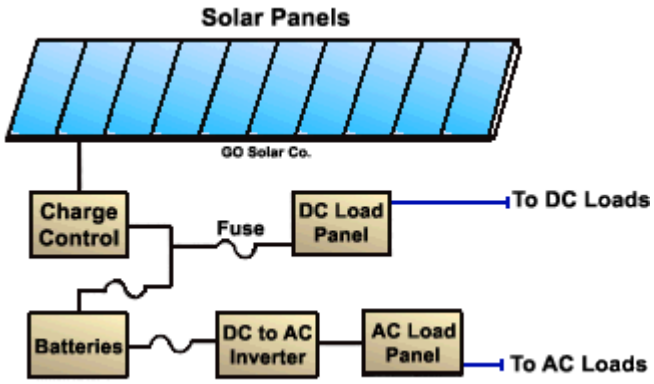

Figure 2.3: Complete Stand-Alone Solar System

A Complete Stand-Alone solar system is useful for complete independence from fossil fuels and electric utility companies. The advantage to this type of system is its ability to provide power away from the utility grid, and to create a measure of self independence. A complete stand-alone home solar system will typically have 2 inverters to supply the AC house current necessary to power large loads such as air conditioners. Having a second inverter helps to insure that power is available when one of the inverters eventually requires servicing. These self contained systems need a sizable battery storage capacity to provide electricity when solar power is unavailable due to prolonged adverse weather conditions. A complete stand-alone solar system will usually require at least 20 solar panels to keep the batteries at a safe and proper state of charge. Typically this type of system is most cost effective when the system is located away from the utility grid.