SOLAR SYSTEM FOR IRRIGATION SYSTEM

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ABSTRACT

Solar power is absolutely perfect for use with irrigation systems for gardens, grass such as golf course, field and especially for planting. Using 12 V Solar Panel, the sun energy will converted to electrical power and saves to 12 V batteries. When the sun is rising and shining, the solar panel will absorb the energy of the sun and the energy will keep in the battery. The battery will supply the power to the water pump. By using the timer, the irrigation system will turn on the pump at the same time every day. We also can use relay to supply the power of the pump or many other pump with our choice to ON/OFF the pump every day. The system will turn OFF when the electrical conductivity probes detect the suitable value of soil moisture.

ABSTRAK

Tenaga solar adalah benar-benar sempurna untuk digunakan dengan sistem pengairan untuk taman-taman rumput, seperti padang golf, padang dan terutamanya untuk penanaman. Menggunakan 12 V Panel Suria, tenaga matahari akan ditukar kepada kuasa elektrik dan menjimatkan hingga 12 V bateri. Apabila matahari naik dan bersinar, panel solar akan menyerap tenaga matahari dan tenaga akan menyimpan dalam bateri. Bateri akan membekalkan kuasa kepada pam air. Dengan menggunakan pemasa, sistem pengairan akan menghidupkan pam pada masa yang sama setiap hari. Kita juga boleh menggunakan geganti untuk membekalkan kuasa pam atau pam lain dengan pilihan kami untuk ON / OFF pam setiap hari. Sistem akan OFF apabila probe kekonduksian elektrik mengesan nilai yang sesuai kelembapan tanah.

TABLES OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

DC	-	Direct current
Vdc	-	Voltage direct current
Vin	-	Input voltage
Vo	-	Output voltage

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

Electricity is a general term encompassing a variety of phenomena resulting from the presence and flow of electric charge. Nowadays, electricity is very important to us. Without electricity, our daily life is not complete. However, electricity tariff is increase due to the gas price [1]. So, alternative energy or renewable energy is suitable for us to gain energy and save our money.

There are many types of alternative energy such as wind, solar energy, nuclear generation, hydroelectric, thermal and many more. The alternative energy that commonly use nowadays is Solar system or Photovoltaic (PV). Photovoltaic (PV) is a method of generating electrical power by converting solar radiationinto direct current electricity using semiconductors that exhibit the photovoltaic effect[2]. Photovoltaic power generation employs solar panels composed of a number of solar cells containing a photovoltaic material.

Thus, in this project, the implementation of solar energy is use for irrigation system. Irrigation system nowadays is not very practical which is time wasting and involving of human power.

There are many type of irrigation system such as surface, drip irrigation, water sprinkler, sub-irrigation and many more. Many of this irrigation system used manual and automatic control. This automatic control use electricity to operate the irrigation system. By using the solar system or photovoltaic system (PV), electricity and money can be save. Besides that, by using automatic irrigation that powered by solar, more time can be saved.

Many benefits that we can get by using this alternative energy.One major advantage with the use of renewable energy is the source is sustainable and it will never run out. Renewable energy facilities generally require less maintenance than traditional generators. Their fuel being derived from natural and available resources reduces the costs of operation.

Even more importantly, renewable energy produces little or no waste products such as carbon dioxide or other chemical pollutants, so it has minimal impact on the environment. Renewable energy projects can also bring economic benefits to many regional areas, as most projects are located away from large urban centers and suburbs of the capital cities. These economic benefits may be from the increased use of local services as well as tourism.

1.2 Problem Statements

Nowadays, raw materials such as natural gas are decreasing and price of this natural gas are increase due to the market price. This natural gas is very important to produce electricity. For example, many Power Generation or Power Plant uses natural gas to produce electricity. So, to minimize the usage of this natural gas, we can use the alternative ways such as solar energy. Besides that, this alternative energy also dot not harm to the environment.

Water is very important to us. There are many usage of water such as for drinks, bath, and to wash clothes. Besides that, water also important to water plant because water can give nutrition to the plant. But, irrigation system that many people use is not very practical. This is because the irrigation nowadays uses the human power. Furthermore, a lot of water has been wasted because of careless management of manual irrigation system. So, by this solar system for irrigation system, many time and water can be saved.

1.3 Project Objective

The objectives of doing this project are

i. To design the simple and practical irrigation system that using Solar Panel.

ii. Develop a smart charger controller to collect and store solar energy in battery.

1.4 Project Scope

a) Build a circuit for irrigation system that using Solar system.

 i. water pump (dc)
 ii. timer
 iii. sensor
 iv. relay switch

b) Build a solar charger controller.

c) Build a controller circuit using Microcontroller

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter presents an overview of solar system. Solar photovoltaic (PV) system has been recognized as suitable for power generation in countries where there are high levels of solar radiation.

2.2 Solar Energy

Sun provided the earth with various energies such as in the form of solar energy, radiant light and heat[5]. These energies have been utilized and develop in human civilization since ancient times. Across the centuries, there are many other alternative energies have been discovered and hence competitions between the sources of energy start from solar radiation to the other resources such as hydroelectricity, wind energy, wave power and also thermal.

2.3 Solar Panel

A solar panel is a collection of solar cells. Although each solar cell provides a relatively small amount of power, many solar cells spread over a large area can provide enough power to be useful. To get the most power, solar panels have to be pointed directly at the Sun. Solar panels need surface area, more exposure means more electricity can be converted from light energy [2].

Solar energy absorbed by solar panel or in other word Photovoltaic Cell (PV). ‘Photo’, meaning light, and ‘voltaic’, meaning electricity. Photovoltaic systems use silicon cells to convert solar radiation into electricity [2].The PV system captures the sun’s energy using solar photovoltaic cells. The cells convert the sunlight into electricity, which can be used to run household appliances and lighting.Each cell is made from one or two layers of semi-conducting material, usually silicon.

Photovoltaic(PV) cells are the special made semiconductor such as silicon, widely use.Basically when the light strikes the cell,a certain portion of it absorbed by semiconductor – energy transferred to semiconductor.Energy knocks the electron, allowing them to move freely. PV also has electric field that only allow electron move in certain direction.This flow of electron we called current[2].

Figure 2.1: Solar Panel

2.3.1 **Monocrystalline Solar Panel**

Monocrystalline silicon often made using the Czochralski process. Single-crystal wafer cells tend to be expensive, and because they are cut from cylindrical ingots, do not completely cover a square solar cell module without a substantial waste of refined silicon[5]. Hence most monocrystalline solar panelhave uncovered gaps at the four corners of the cells.

2.3.2 Polycrystalline Solar Panel

Polycrystalline silicon, ormulticrystalline silicon, (poly-Si or mc-Si): made from cast square ingots — large blocks of molten silicon carefully cooled and solidified. Polycrystalline cells are less expensive to produce than single crystal silicon cells, but are less efficient. However, there were a higher number of multicrystalline sales than monocrystalline silicon sales due to the economical cost[2].

2.3.3 Thin-Film Solar Panel

Thin-film technologies reduce the amount of material required in creating the active material of solar cell. Though this reduces material cost, it may also reduce energy conversion efficiency. Thin-film silicon cells have become popular due to cost, flexibility, lighter weight, and ease of integration, compared to wafer silicon cells.

Diodes are often included to avoid overheating of cell in case of partial shading. Since cell heating reduces the operating efficiency it is desirable to minimize the heating. Very few modules incorporate any design features to decrease temperature, however installer try to provide good ventilation behind the module.

The power produced by the solar array depends on the weather conditions, the position of the sun and the capacity of the array. At noon on a bright day, a good array can produce over 2 kilowatt (2.6 hp). A 6 m^2 array of 20 % cell will produce roughly 6 kW-h (22 kJ) of energy during typical day on the Malaysia weather at daily insulation of 4 hours[6].

In brief, thin-film solar panel are the suitable commercially viable photovoltaic solar collectors among three type solar panel. PV panel made from thin-film is suitable for Malaysia weather [2].

2.4 Battery

A battery, which is actually an electric cell, is a device that produces electricity from a chemical reaction. Strictly speaking, a battery consists of two or more cells connected in series or parallel, but the term is generally used for a single cell. A cell consists of a negative electrode; an electrolyte, which conducts ions; a separator, also an ion conductor; and a positive electrode.

The electrolyte may be aqueous (composed of water) or non-aqueous (not composed of water), in liquid, paste, or solid form. When the cell is connected to an external load, or device to be powered, the negative electrode supplies a current of electrons that flow through the load and are accepted by the positive electrode. When the external load is removed the reaction ceases.

A primary battery is one that can convert its chemicals into electricity only once and then must be discarded. A secondary battery has electrodes that can be reconstituted by passing electricity back through it; also called a storage or rechargeable battery, it can be reused many times.

Figure 2.2: Battery

2.4.1 Nickel Cadmium (Ni-Cd)

Nickel Cadmium (Ni-Cd) batteries were the standard technology for years, but today they are out of date and new laptops don't use them anymore. They are heavy and very prone to the "memory effect". When recharging a NiCd battery that has not been fully discharged, it "remembers" the old charge and continues there the next time you use it[17]. The memory effect is caused by crystallization of the battery's substances and can permanently reduce your battery's lifetime, even make it useless. To avoid it, you should completely discharge the battery and then fully recharge it again at least once every few weeks. As this battery contains cadmium, a toxic material, it should always be recycled or disposed of properly.

NiCad batteries, and to a some degree NiMH batteries, suffer from what's called the memory effect [17]. Memory Effect means that if a battery is repeatedly only partially discharged before recharging, the battery will forget that it can further discharge. The best way to prevent this situation is to fully charge and discharge your battery on a regular basis.

2.4.2 Lithium Ion (Li-ion)

Lithium Ion (Li-ion) are the new standard for portable power. Li-ion batteries produce the same energy as NiMH but weighs approximately 20%-35% less[18]. They do not suffer significantly from the memory effect unlike their NiMH and Ni-Cd counterparts. Their substances are non-hazardous to the 0.

Because lithium ignites very easily, they require special handling. Unfortunately, few consumer recycling programs have been established for Li-ion batteries at this point in time.

Figure 2.3: Lithium Ion battery

2.4.3 Lead Acid

A lead-acid battery is a electrical storage device that uses a reversible chemical reaction to store energy. It uses a combination of lead plates or grids and an electrolyte consisting of a diluted sulphuric acid to convert electrical energy into potential chemical energy and back again [19]. The electrolyte of lead-acid batteries is hazardous to your health and may produce burns and other permanent damage if you come into contact with it. Thus, when dealing with electrolyte protect yourself appropriately.

Figure 2.4: Lead Acid battery

After all, a few properties have been determined where a battery should:

a. Provide enough voltage at full charge roughly around 12 V to 12.8 V
b. High discharge down rate as much as least 60% and above at time after time.
c. Not easily damaged by excessive rate of overcharge, discharge or even negative charge within to tolerable range.
d. Safe in operation when exposed to harsh ambient environment
e. Low in cost since more than one cell is required

Thus, on the whole that deep cycle lead acid batteries perform the overall characteristic to be used in the project. A deep cycle lead acid battery is designed to be regularly discharged to most of its capacity.

Besides that, it is sufficient to powered output to load more than 12 V[19]. Certainly, the low cost of deep cycle lead acid battery is an attractive point beside less dangerous compare to volatile lithium-ion cell. Therefore, deep-cycle lead acid batteries are more suitable to be installed in stand-alone solar system in rural area in this project.

2.5 Timer

A timer is a specialized type of clock. A timer can be used to control the sequence of an event or process[4]. Whereas a stopwatch counts upwards from zero for measuring elapsed time, a timer counts down from a specified time interval, like an hourglass. Timers can bemechanical, electromechanical, electronic (quartz), or even software as all modern computers include digital timers of one kind or another. When the set period expires some timers simply indicate so (e.g., by an audible signal), while others operate electrical switches, such as atime switch, which cuts electrical power.

Figure 2.5: Programmable Timer

2.5.1 Mechanical Timer

Mechanical timers regulate their speed. Inaccurate, cheap mechanisms use a flat beater that spins against air resistance. Mechanical egg-timersare sometimes of this type.More accurate mechanisms have mechanisms similar to mechanical alarm clocks; they require no power, and can be stored for long periods of time. The most widely-known application is to control explosives.

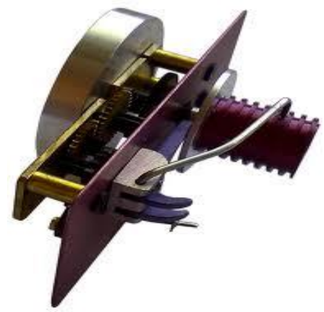

Figure 2.6: Mechanical Timer

2.5.2 Electromechanical Timer

Short-period bimetallic electromechanical timers use a thermal mechanism, with a metal finger made of strips of two metals with different rates of thermal expansion sandwiched together; steel and bronze are common. An electric currentflowing through this finger causes heating of the metals, one side expands less than the other, and an electrical contact on the end of the finger moves away from or towards an electrical switch contact[7]. The most common use of this type is in the "flasher" units that flash turn signals in automobiles, and sometimes in Christmas lights. This is a non-electronic type of multivibrator.

An electromechanical cam timer uses a small synchronous AC motor turning a cam against a comb of switchcontacts. The AC motor is turned at an accurate rate by the alternating current, which power companies carefully regulate. Gears drive a shaft at the desired rate, and turn the cam. The most common application of this timer now is in washers, driers and dishwashers. This type of timer often has a friction clutch between the gear train and the cam, so that the cam can be turned to reset the time [9].

Electromechanical timers survive in these applications because mechanical switch contacts may still be less expensive than the semiconductor devices needed to control powerful lights, motors and heaters.In the past these electromechanical timers were often combined with electrical relays to create electro-mechanical controllers. Electromechanical timers reached a high state of development in the 1950s and 60s because of their extensive use in aerospace and weapons systems. Programmable electromechanical timers controlled launch sequence events in early rockets and ballistic missiles[8]. As digital electronics has progressed and dropped in price, electronic timers have become more advantageous.

2.5.3 Electronic Timer

Electronic timers are essentially quartz clocks with special electronics, and can achieve higher precision than mechanical timers. Electronic timers have digital electronics, but may have an analog or digital display. Integrated circuits have made digital logic so inexpensive that an electronic timer is now less expensive than many mechanical and electromechanical timers[10]. Individual timers are implemented as a simple single-chip computer system, similar to a watch and usually using the same, mass-produced, technology.

Many timers are now implemented in software. Modern controllers use a programmable logic controller rather than a box full of electromechanical parts. The logic is usually designed as if it were relays, using a special computer language called ladder logic. In PLCs, timers are usually simulated by the software built into the controller. Each timer is just an entry in a table maintained by the software. Digital timers are used in safety device such as a gas timer.

Figure 2.7: Electronic Timer