'Saya akui bahawa telah membaca
karya ini dan pada pandangan saya karya ini
adalah memadai dari segi skop dan kualiti untuk tujuan penganugerahan
Ijazah Sarjana Muda Kejuruteraan Mekanikal (Struktur dan Bahan)'

Tandatangan : .....

Nama Penyelia : MOHD AFZANIZAM B. MOHD ROSLI

Tarikh : 15/5/2009

DESIGN OF AUTOMATIC GATE POWERED BY SOLAR ENERGY

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This report is proposed as to full fill the recommendation for Bachelor of Mechanical Engineering (Structure and Material) award.

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"I admit this report is my own work effort except for the summaries and quotations that I had explain its sources for each of them"

Signature :

Author's Name : Amirul Fariq Bin Ramly

Date : 10 April 2009

This report is dedicated to my beloved parents who were always supporting me till the end and never give up.

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ABSTRACT

Projek Sarjana Muda (PSM) is regarding a study of automatic gate powered by solar energy. This project collects all the relevant information about solar energy concept, the application of solar energy, optimum requirement of solar panel and the suitable size for solar panel. The system used the solar energy to power the automatic gate as the main energy or additional energy. The case study is about to study whether this system can support the usage of the automatic gate or not, and it is compatible or need another research and development to operate in excellent condition.

Throughout observation and understanding, the solar energy is a suitable and available power source that could produce efficient output to the automatic gate, but need the suitable scale of solar panel to ensure enough energy been collected to power the automatic gate. So, study and design a system that can be applied to the automatic gate to generate electricity.

This system will provide the main electric power for the automatic gate, which is to save the cost for electricity usage. A study has been conduct whether this system can power the electricity alone without conventional electricity. This study can see weather this system is relevant or not for the automatic gate. This case study is not mandatory to conclude this solar energy is the best way or not but can the solar energy been used efficiently. In this project, a study was conduct about the system and the device that can be used in this system to generate electricity.

Besides that, the initial installation cost for this system also has been considered because the cost for solar panel is very expensive, and it takes a long time for return of investment but this system can operate anytime even though blackout occur as long the system restored the electricity.

ABSTRAK

Projek Sarjana Muda (PSM) adalah mengenai satu kajian pintu pagar automatik yang dikuasakan oleh tenaga suria. Projek ini mengambil semua maklumat yang relevan mengenai konsep tenaga suria, aplikasi tenaga suria, keperluan optimum panel suria dan saiz yang sesuai untuk panel suria. Sistem ini menggunakan tenaga suria untuk menggerakkan pintu pagar automatik sebagai tenaga utama atau tenaga tambahan. Kajian kes ialah mengkaji sama ada sistem ini boleh menyokong penggunaan pintu pagar automatik atau tidak, dan ia serasi atau memerlukan penyelidikan dan pembangunan untuk pengendalian dalam situasi terbaik.

Sepanjang pemerhatian dan pemahaman, tenaga suria ini merupakan satu sumber kuasa yang sesuai dan boleh didapati yang boleh mengeluarkan output yang cekap untuk pintu pagar automatik, tetapi memerlukan skala panel suria yang sesuai untuk memastikan tenaga yang cukup di kumpul untuk menggerakkan pintu pagar automatik. Jadi, kajian dan reka bentuk satu sistem yang boleh digunakan ke atas pintu pagar automatik untuk menjanakan kuasa elektrik.

Sistem ini akan menyediakan kuasa elektrik utama untuk pintu pagar automatik, untuk menjimatkan kos penggunaan tenaga elektrik. Satu kajian telah dijalankan sama ada sistem ini boleh menjanakan elektrik bersendirian tanpa tenaga elektrik konvensional. Kajian ini dapat menunjukkan samada sistem ini sesuai atau tidak untuk pintu pagar automatik. Kajian kes ini bukan mandatori untuk menunjukkan tenaga suria merupakan jalan terbaik atau tidak tetapi menunjukkan tenaga suria boleh digunakan dengan cekap. Dalam projek ini, satu kajian telah dijalankan mengenai sistem ini dan peranti yang boleh digunakan dalam sistem untuk menjanakan kuasa elektrik.

Selain itu, kos pemasangan permulaan untuk sistem ini juga telah dipertimbangkan kerana kos untuk panel suria mahal , dan ia mengambil masa yang lama untuk pulangan pelaburan tetapi sistem ini boleh beroperasi bila-bila masa walaupun terputus bekalan elektrik selagi sistem ini menyimpan bekalan elektrik.

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PV	=	photovoltaic
SPV	=	standalone photovoltaic
W_p	=	peak watt
T_{cell}	=	solar cell temperature
$T_{ambient}$	=	ambient temperatures
T_{module}	=	solar module temperature
H	=	the average solar radiation over a day in the units of kW/m^2
$P_{pv\ max}$	=	the maximum power output of the solar array under a solar radiation of 1000 W/m^2
ρ	=	the negative temperature coefficient of power with respect to solar cell temperature provided by the manufacturers
η_c	=	are the factors representing connection losses
η_o	=	other losses such as those caused by accumulative dust
$E_B(n)$	=	the energy stored in the battery on day n
$E_B(n-1)$	=	energy stored in the battery on day $n-1$
η_s	=	the daily battery self-discharge rate
$E_{pv}(n)$	=	the energy generated by the solar array on day n
$E_L(n)$	=	the load demand on day n
η_{inv}	=	the efficiency of the inverter
η_{batt}	=	the charge efficiency of the battery
$E_{B\ max}$	=	the maximum allowable energy level
$E_{B\ min}$	=	the minimum allowable energy level
C_{batt}	=	capacity of the battery
V_{rated}	=	rated voltage
PSHs	=	peak sun hours
MPPT	=	maximum power point tracker
DOD	=	depth of discharge

SOC	=	state of charge
LPSP	=	loss of power supply probability
SOC(n)	=	the SOC when the systems stay on the nth day
LPS(n)	=	the loss of energy supply on day n
C_{sys}	=	the total costs of the systems
C_{pv}	=	the capacity of the solar array
C_{batt}	=	the capacity of the battery
C_{other}	=	the other total costs except the solar array and the battery
α	=	the unit cost of the battery (\$/A h)
β	=	the unit cost of the solar array (\$/W_p)

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CHAPTER 1

INTRODUCTION

1.1 Background

Almost all the renewable energy sources originate entirely from the sun. The sun's rays that reach the outer atmosphere are subjected to absorption, reflection, and transmission processes through the atmosphere before reaching the earth's surface. On the other hand, depending on the earth's surface topography, as explained by Neuwirth (1980), the solar radiation shows different appearances.

The emergence of interest in solar energy utilization has taken place since 1970, principally due to the then rising cost of energy from conventional sources. Solar radiation is the worlds most abundant and permanent energy source. The amount of solar energy received by the surface of the earth per minute is greater than the energy utilization by the entire population in one year. For the time being, solar energy, being available everywhere, is attractive for stand-alone systems particularly in the rural parts of developing nations. Occurrences of solar energy dynamically all over the world in the forms of wind, wave, and hydropower through the hydrological cycle provide abilities to ponder about their utilization, if possible instantly or in the form of reserves by various conversion facilities and technologies. It is also possible that in the very long term, human beings might search for the conversion of ocean currents and

temperature differences into appreciable quantities of energy so that the very end product of solar radiation on the earth will be useful for sustainable development.

The design of many technical apparatuses such as coolers, heaters, and solar energy electricity generators in the form of photovoltaic cells, requires terrestrial irradiation data at the study area. Scientific and technological studies in the last three decades tried to convert the continuity of solar energy into sustainability for the human comfort. Accurate estimations of global solar radiation need meteorological, geographic, and astronomical data and especially, many estimation models are based on the easily measurable sunshine duration at a set of meteorology stations.

Solar energy is referred to as renewable and/or sustainable energy because it will be available as long as the sun continues to shine. Estimates for the life of the main stage of the sun are another 4 – 5 billion years. The energy from the sunshine, electromagnetic radiation, is referred to as insulation.

Solar energy is the utilization of the radiant energy from the sun. Solar power is used interchangeably with solar energy but refers more specifically to the conversion of sunlight into electricity by photovoltaic and concentrating solar thermal devices, or by one of several experimental technologies such as thermoelectric converters, solar chimneys and solar ponds. Solar energy and shading are important considerations in building design. Thermal mass is used to conserve the heat that sunshine delivers to all buildings. Day lighting techniques optimize the use of light in buildings. Solar water heaters heat swimming pools and provide domestic hot water. In agriculture, greenhouses expand growing seasons and photovoltaic-powered pumps provide water for grazing animals. Evaporation ponds are used to harvest salt and clean waste streams of contaminants. Solar energy is the fastest growing form of energy production. Solar distillation and disinfection techniques produce potable water for millions of people worldwide. Family-scale solar cookers and larger solar kitchens concentrate sunlight for cooking, drying and pasteurization. Clotheslines are a common application of solar energy. More sophisticated concentrating technologies magnify the rays of the sun for

high-temperature material testing, metal smelting and industrial chemical production. A range of prototype solar vehicles provide ground, air and sea transportation.

Solar energy also used for operating automatic gates. Automatic gates are an easy way to ensure the security of private premises and can be used for all sized properties. Automatic gates, though not very commonplace at the moment, have found their niche in the market today. For those who find the security of their premises (be it residential or commercial) important, automatic gates are the way to go. There is a decrease in the cost of automatic gate kits and their installation. Aside from the basic kits, there are now many features that can be added to ensure security as well as make them more convenient.

1.2 Objective

The main objectives for this project are to design the best concept of automatic gate using solar energy and fabricate a model of the project after doing proper research.

1.3 Scope

The scopes of this project are:

a) Study the solar energy concept

b) Apply solar energy concept for application

c) Investigate the optimum requirement of solar panel (design, cost)

d) Study the suitable solar panel (size)

e) Study about automatic gate (sliding or swing type)

1.4 Problem Statement

Normally, the automatic gate is powered by motor which are using electric power or battery. But this is costly since we use our gate everyday and the gate consumes electricity so much. There are also problems when no electricity at home, the gate won't work automatically. To reduce the consumption of electricity, the alternative power such as solar energy is implement to overcome the issue. Solar energy is free to use and we only have to pay for the installment. Automatic gate powered by solar also can work at night and when there are no electricity at home.

I have to create a solar device which can make and keep solar energy in all weather condition for example raining. I also have to connect the solar device to mechanical component of the automatic gate so the gate will function same as using electric power. As for reducing cost, I have to calculate the minimum solar energy to move the gate open and close.

CHAPTER 2

LITERATURE RIVIEW

2.1 Solar Energy

The sun is a sphere of intensely hot gaseous matter with a diameter of 1.39×10^{9} m. The solar energy strikes our planet a mere 8 min and 20 s after leaving the giant furnace, the sun which is 1.5×10^{11} m away. The sun has an effective blackbody temperature of 5762 K. The temperature in the central region is much higher and it is estimated at 8×10^{6} to 40×10^{6} K. In effect the sun is a continuous fusion reactor in which hydrogen is turned into helium. The sun's total energy output is 3.8×10^{20} MW which is equal to 63 MW/m^2 of the sun's surface. This energy radiates outwards in all directions. Only a tiny fraction, 1.7×10^{14} kW, of the total radiation emitted is intercepted by the

earth. However, even with this small fraction it is estimated that 30 min of solar radiation falling on earth is equal to the world energy demand for one year (Kalogirou 2004).

Man realized that a good use of solar energy is in his benefit, from the prehistoric times. The Greek historian Xenophon in his ‘memorabilia’ records some of the teachings of the Greek Philosopher Socrates (470–399 BC) regarding the correct orientation of dwellings in order to have houses which were cool in summer and warm in winter.

Since prehistory, the sun has dried and preserved man's food. It has also evaporated sea water to yield salt. Since man began to reason, he has recognized the sun as a motive power behind every natural phenomenon. This is why many of the prehistoric tribes considered Sun as ‘God’. Many scripts of ancient Egypt say that the Great Pyramid, one of the man's greatest engineering achievements, was built as a stairway to the sun.

Basically, all the forms of energy in the world as we know it are solar in origin. Oil, coal, natural gas and woods were originally produced by photosynthetic processes, followed by complex chemical reactions in which decaying vegetation was subjected to very high temperatures and pressures over a long period of time. Even the wind and tide energy have a solar origin since they are caused by differences in temperature in various regions of the earth (Kalogirou 2004).

The greatest advantage of solar energy as compared with other forms of energy is that it is clean and can be supplied without any environmental pollution. Over the past century fossil fuels have provided most of our energy because these are much cheaper and more convenient than energy from alternative energy sources, and until recently environmental pollution has been of little concern (Kalogirou 2004).

Twelve winter days of 1973 changed the economic relation of fuel and energy when the Egyptian army stormed across the Suez Canal on October the 12th provoking an international crisis and for the first time, involved as part of Arab strategy, the threat