FEASIBILITY STUDY OF SOLAR POWERED BICYCLE RACE

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"References of information from other sources are quoted accordingly; otherwise the information presented in this report is solely work of the author."

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ABSTRACT

There are many solar race in this era such as solar bicycle race, solar car race and other. Because of solar race regulations system which have similarities in using battery as storage power, the idea to customize the system solar race especially solar bicycle race come to mind. This study purpose is to develop guideline for solar powered bicycle race and prove the feasibility with simulation. So, this study is based on choosing the suitable components and the relations between them. With the suitable selection of the components in this study, guideline has been developed as the strategy to win the race. This study will use fully solar powered as energy to move the bicycle. The result of this study will produce a bicycle that can finish the race in below 19 second in 100 meter. This thesis can be use as a reference and guideline to other people or organization to organize a solar bicycle race competition.

ABSTRAK

Terdapat pelbagai perlumbaan solar pada era ini seperti perlumbaan basikal solar, perlumbaan kereta solar dan lain-lain. Oleh kerana terdapat banyak peraturan perlumbaan solar basikal yang hampir sama seperti penggunaan bateri sebagai tempat menyimpan kuasa, satu idea untuk mengubah Kajian ini adalah untuk membangunkan satu garis panduan basikal lumba solar dan membuktikan garis panduan ini dengan melakukan kaedah simulasi. Oleh itu, kajian ini adalah untuk memilih komponen-komponen basikal lumba solar dan hubungan antara setiap komponen. Dengan pemilihan komponen ini, strategi untuk memenangi perlumbaan di susun. Kajian ini akan menggunakan seluruh kuasa daripada solar sebagai tenaga untuk menggerakkan basikal. Hasil daripada kajian ini menunjukkan basikal in dapat menghabiskan jarak 100 meter dengan masa bawah 9 saat. Kajian ini boleh dijadikan sebagai rujukan dan garis panduan kepada orang ramai dan organisasi yang hendak melakukan perlumbaan basikal solar.

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LIST OF ABBREVIATIONS

SPBR	Solar Powered Bicycle Race
AC	Alternate Current
CHS	Convection Heat Storage
DC	Direct Current
LED	Light Emitting Diode
ICS	Integrated Collector Storage
PV	Photovoltaic
USA	United States of America
SMK	Sekolah Menengah Kebangsaan

CHAPTER 1

INTRODUCTION

1.1 Introduction

A solar powered bicycle is an electric vehicle powered by solar energy obtained from solar panels the on vehicle. Photovoltaic (PV) cells convert the sun's energy directly into electrical energy.

Solar bicycle racing refers to competitive races bicycle which are powered by solar energy obtained from solar panels on the bicycle. Solar bicycle race almost same like normal solar bicycle but the difference between solar bicycle race and normal solar bicycle is performance and composite or type every component. Such as the type of solar panel, motor drive and bicycle metal.

The main component of solar powered bicycle race is a bicycle. Size of the bicycle is very important to make sure the solar bicycle is not carrying extra weight. This is because that weight can reduce the speed of the solar bicycle.

The other main component in solar powered bicycle race is motor. Motor is needed to give a kinetic energy to move the bicycle. Suitable motor is very important to give a high performance and maximum condition of solar powered bicycle race. The solar panel located at the back of the bicycle. This is for make sure aerodynamic of the bicycle is efficient and the value of the wind resistance is small.

Solar bicycle races advantage is to promote the development of alternative energy technology such as solar cells. Such challenges are often entered by universities to develop their students' engineering and technological skills, but many business corporations have entered competitions in the past. A small number of high school teams participate in solar car races designed exclusively for high school students.

1.2 Problem Statement

Solar race competition is very famous in big country like a USA[1]. One of the famous solar race is solar bicycle race. Their organizer very excited to make solar bicycle race competition until this race competition is make every single year. Their people very interest to participate in this race. This is because they are interested doing research in renewable energy like a solar powered vehicle. Effect of this situation, many guideline and strategy for solar vehicles like a solar powered bicycle race is develop. But It’s difference from Malaysia, solar bicycle race competition is not famous in Malaysia because don’t have any organizer interest to doing this competition. If have the organizer interest organize the solar bicycle race competition, Malaysia people just join the race for fun. They want be a champion but they not interest to doing the research in order to be a champion in solar bicycle race. So, Malaysia doesn’t have any solar bicycle guideline.

1.3 Photovoltaic Energy

The term "photovoltaic" has two parts: photo, a Greek word meaning light, and voltaic, a reference to electrical energy innovator Alessandro Volta. In 1839, French physicist Edmond Becquerel discovered the photovoltaic effect, the production of a volt by use of a semiconductor[2]. This discovery prompted further experimentation with light sources and semiconductors, which led to the invention of solar cells that produce photovoltaic energy.

Photovoltaic's (PV) is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect**.** These semiconducting cells are usually made of silicon and do not contain any corrosive materials or moving parts. As long as the solar cells are exposed to light, they will produce photovoltaic energy with a minimum of maintenance. This energy is also environmentally clean, quiet, and safe.

The resulting output of photovoltaic energy is dependent upon the size of the array. The size may vary, depending on the amount of available sunlight and the amount of power needed. Even though the power output of a photovoltaic energy system depends on the overall amount of light exposure, it will still generate energy on cloudy or overcast days. To store this energy for later transmission, a variety of storage systems are available to consumers. Most reliable storage systems use a combination of rechargeable batteries and energy-storing capacitors, some of which can be designed for AC or DC power.

The amount of power available on cloudy days and at night in a photovoltaic energy system depends on the energy output of the photovoltaic modules and the battery

arrangement. Adding additional modules and batteries will increase the available power, but will also increase the cost of the system. For best results, a thorough analysis of needs vs. cost must be conducted in order to create a system design that will balance cost and need with convenience of use. Systems that are well-designed offer the opportunity for expansion or reduction as energy needs increase or decrease.

1.4 Objectives

1. To develop guideline for the solar powered bicycle race.

2. To prove the feasibility of solar powered bicycle race.

1.5 Scopes of Project

This study will focus on the design a workable of solar powered bicycle by means of photovoltaic energy. However battery as energy to energize solar powered bicycle race movement is out of the study. Scope on this study is focus on efficiency of this solar powered bicycle race . The limitation of this study is focus on one group of rider of solar powered bicycle race. Since the result of study is not know either feasible or not this solar powered bicycle race take part in race, therefore no hardware will be built as model of solar powered bicycle race. On the other hand, this study are use combination of the calculation technique and specification to develop guideline of solar

powered bicycle race. Excel software will use for simulate to prove the guideline of solar powered bicycle race. For this study, track distance 100 meter will use.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Solar energy, radiant light and heat from the sun, has been harnessed by humans since ancient times using a range of ever-evolving technologies. Solar radiation, along with secondary solar-powered 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 powered electrical generation relies on heat engines and photovoltaic. Solar energy's uses are limited only by human ingenuity. A partial list of solar applications includes space heating and cooling through solar architecture, potable water via distillation and disinfection, day lighting, solar hot water, solar cooking, and high temperature process heat for industrial purposes. To harvest the solar energy, the most common way is to use solar panels.

Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy. Active solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy. 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.

The Earth receives 174 petawatts (PW) of incoming solar radiation (insulation) at the upper atmosphere[3]. Approximately 30% is reflected back to space while the rest is absorbed by clouds, oceans and land masses. The spectrum of solar light at the Earth's surface is mostly spread across the visible and near-infrared ranges with a small part in the near-ultraviolet.[4]

Earth's land surface, oceans and atmosphere absorb solar radiation, and this raises their temperature. Warm air containing evaporated water from the oceans rises, causing atmospheric circulation or convection. When the air reaches a high altitude, where the temperature is low, water vapor condenses into clouds, which rain onto the Earth's surface, completing the water cycle. The latent heat of water condensation amplifies convection, producing atmospheric phenomena such as wind, cyclones and anti-cyclones[5]. Sunlight absorbed by the oceans and land masses keeps the surface at an average temperature of 14 °C[6]. By photosynthesis green plants convert solar energy into chemical energy, which produces food, wood and the biomass from which fossil fuels are derived[7].

2.2 Solar Powered Pump

These solar applications made economic sense because the location was too remote to run a long power line. A solar-powered water system is one of the easiest solar power systems to install, since not need a battery or battery charging equipment. When the sun is shining, the system is pumping, when the sun is not shining, the system is off.

By adding a storage tank and increasing the size of the pumping system, excess pumped water can be stored, which can continue to supply water during the night or when it’s cloudy and the pump is off.

Low voltage DC pumps designed to operate on solar power are not designed like 220-volt AC water pumps. A DC water pump is designed to pump using the absolute minimum of electrical power. Unfortunately, this also usually means a very low flow rate, so having a storage tank or open trough is essential.

Although the flow rate can be less than one gallon per minute (GPM) for the smaller pump sizes, this small flow will be fairly constant throughout the solar day (9 AM to 3 PM for most locations). This low flow rate can still provide over 350 gallons of water per day from all but the deepest well applications.

A solar module can be mounted almost anywhere. Most farm and ranch applications should have the modules and pump controller mounted on a raised pole to stay above snow drifts and potential damage from animals.

2.2.1 Controller

Each residential-size solar module will produce a fairly constant 17-volts output at almost any level of sunlight. However, the current output (amps) will be directly proportional to sun intensity. The pump will have a minimum current draw when stalled and no pumping is taking place. As the voltage is increased, pump rotation and water pumping is increased as long as enough current is available. During less than ideal solar periods, the current output of the solar module(s) can be below the amp draw required for the pump to begin pumping. A solar pump controller will convert any excess voltage of the solar array to more output current.

The resulting lower voltage will not provide the normal flow output from the slower turning pump, but it will allow reduced flow during those hours the pump will normally be "stalled." In addition to matching the voltage and current load of the pump with the charging current and voltage output of the solar module, a solar-pump controller also includes wiring terminals for normally open (n.o.) and normally closed (n.c.) switch contacts. This makes it easy to add a high and low level float switch to the storage tank, or a low-limit float switch for the well or pond providing the water source.

2.3 Solar powered vehicles

A solar vehicle is an electric vehicle powered by solar electricity. This is obtained from solar panels on the surface (generally, the top or window) of the vehicle or using a solar jacket in electric bicycles. Photovoltaic (PV) cells convert the sun's energy directly into electrical energy.

Solar vehicles are not sold as practical day-to-day transportation devices at present, but are primarily demonstration vehicles and engineering exercises, often sponsored by government agencies. However indirectly solar-charged vehicles are widespread and solar boats are available commercially.

2.3.1 Solar Car

Solar cars combine technology typically used in the aerospace, bicycle, alternative energy and automotive industries. The design of a solar vehicle is severely limited by the amount of energy input into the car. Most solar cars have been built for the purpose of solar car races. Exceptions include solar-powered cars and utility vehicles.

Solar cars are often fitted with gauges as seen in conventional cars. In order to keep the car running smoothly, the driver must keep an eye on these gauges to spot possible problems. Cars without gauges almost always feature wireless telemetry, which allows the driver's team to monitor the car's energy consumption, solar energy capture and other parameters and free the driver to concentrate on driving.

Solar cars depend on PV cells to convert sunlight into electricity. In fact, 51% of sunlight actually enters the Earth's atmosphere[8]. Unlike solar thermal energy which converts solar energy to heat for either household purposes, industrial purposes or to be converted to electricity, PV cells directly convert sunlight into electricity[9]. When sunlight (photons) strike PV cells, they excite electrons and allow them to flow, creating an electrical current. PV cells are made of semiconductor materials such as silicon and

alloys of indium, gallium and nitrogen. Silicon is the most common material used and has an efficiency rate of 15-20%. Of late, several consulting companies, such as Phoenix Snider Power, have started offering technical and financial services to institutes and teams developing solar cars worldwide.

2.3.2 Solar Bicycle and Motorcycle

A solar bicycle or tricycle has the advantage of very low weight and can use the riders foot power to supplement the power generated by the solar panel roof. In this way, a comparatively simple and inexpensive vehicle can be driven without the use of any fossil fuels[10].

Solar photovoltaic’s helped power India's first Quadricycle developed since 1996 in Gujarat state's SURAT city[11]. The first solar "cars" were actually tricycles or quadricycles built with bicycle technology. These were called solarmobiles at the first solar race, the Tour de Sol in Switzerland in 1985 with 72 participants, half using exclusively solar power and half solar-human-powered hybrids. A few true solar bicycles were built, either with a large solar roof, a small rear panel, or a trailer with a solar panel. Later more practical solar bicycles were built with foldable panels to be set up only during parking. Even later the panels were left at home, feeding into the electric mains, and the bicycles charged from the mains. Today highly developed electric bicycles are available and these use so little power that it costs little to buy the equivalent amount of solar electricity. The "solar" has evolved from actual hardware to an indirect accounting system. The same system also works for electric motorcycles, which were also first developed for the Tour de Sol. This is rapidly becoming an era of solar production[12].

2.3.3 Solar Ships

Solar powered boats have mainly been limited to rivers and canals, but in 2007 an experimental 14m catamaran, the Sun21 sailed the Atlantic from Seville to Miami, and from there to New York[13].

Japan's biggest shipping line Nippon Yusen KK and Nippon Oil Corporation said solar panels capable of generating 40 kilowatts of electricity would be placed on top of a 60,213 ton car carrier ship to be used by Toyota Motor Corporation[12][13][14]. Tûranor Planet Solar is the biggest solar ship[14]. It is planned to be the first ship using only solar power to circumnavigate the globe.

2.3.4 Solar Airplanes

A solar-powered aircraft in Switzerland completed a 26-hour test flight starting at 7 a.m. on 8 July 2010 which ended at 9 a.m. the next day. The plane was flown to a height of nearly 28,000 feet (8,500 meters) by Andre Borschberg. During the evening, the plane slowly descended to an altitude of 4,500 feet (1,500 meters), where it remained for the rest of the night using battery power. An hour before dawn, the plane still had six hours of flying time left in its solar-fueled batteries[16].