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Solar Campus Traveler for In-Campus Personal Transportation System to Carry Up To 90 Kg Load

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***Abstract*: Campus traveller is sportive it may not cost substantially more energy to drive the solar campus traveller, When there is no sunlight the batteries are charged the bycle should be running.A solar traveller bycle has the advantage of it can weight upto 80 to 90kg and can use the riders foot power to supplement the power generated by the solar panel. In this way, a comparatively simple and in expensive vehicle can be driven without the use of any fossil fuels.The solar traveller is easily accessible, safe and practical with limited maintenance requirements due to a fewer mechanical parts. It is ideal not only for the experienced cyclists but also for those non athletes, the elderly and individuals with health problems.Normal campus traveller need large and heavy batteries to allow riding long distances, because the battery is charged only once at home. The solar bike approach is different the photo voltaic panels have enough power and give the traveller an infinite range.This traveller is supported with a switch array to move this in different directions using H-Bridge IC. High torque DC motors are arranged for the movement. Solar panel charges the battery for the functionality of all these modules.**

***Index Terms*: solar traveler, in campus**

I. INTRODUCTION

In this we are discussing about the various component which we will use. As we know that there are different types of components are available in market. The components we are using are brushless DC motor, Solar panel, Battery, charge controller throttle. Hand-powered tricycles are presently being used to provide mobility for disabled persons. With this project we designed and manufactured a system to convert the hand powered tricycle to an electric motor powered version. Solar-powered vehicles (SPVs) use photovoltaic (PV) cells to convert sunlight into electricity. The electricity goes either directly to an electric motor powering the vehicle, or to a special storage battery. PV cells produce electricity only when the sun is shining. Without sunlight, a solar powered car depends on electricity stored in its batteries. There are several types of tricycle that can be categories that is paddle tricycle, motorized tricycle, and electric tricycle. The weakness of the tricycle make people do not like to used tricycle. First, paddle tricycle needs a lot of energy to paddle the tricycle. Next, motorize tricycle that used fuel as it prime mover. The tricycle use fuel that is costly. Besides that, motorize tricycle will make pollution that can be very bad for our environment especially in this period that global warming happen to the earth. Lastly, electric tricycle that generate by battery can be only be sufficient for about an hour. The user needs to find power supply to recharge the battery or else they need to paddle the tricycle that used more energy compare to the normal tricycle because of the weight.

II. COMPONENTS OF SOLAR SYSTEM

2.1. Solar panel:

Photovoltaic is the field of technology and research related to the devices which directly convert sunlight into electricity. The solar cell is the elementary building block of the photovoltaic technology. Solar cells are made of semiconductor materials, such as silicon. One of the properties of semiconductors that makes them most useful is that their conductivity may easily be modified by introducing impurities into their crystal lattice. For instance, in the fabrication of a photovoltaic solar cell, silicon, which has four valence electrons, is treated to increase its conductivity. On one side of the cell, the impurities, which are phosphorus atoms with five valence electrons (n-donor), donate weakly bound valence electrons to the silicon material, creating excess negative charge carriers. On the other side, atoms of boron with three valence electrons (p-donor) create a greater affinity than silicon to attract electrons. Because the-type silicon is in intimate contact with the n-type silicone p-n junction is established and a diffusion of electrons occurs from the region of high electron concentration (the n type side) into the region of low electron concentration (p-type side). When the electrons diffuse across the p-n junction, they recombine with holes on the p-type side. However, the diffusion of carriers does not occur indefinitely, because the imbalance of charge immediately on either sides of the junction originates an electric field. This electric field forms a diode that promotes current to flow in only one direction. Ohm metal semiconductor contacts are made to both the n-type and p-type sides of the solar cell, and the electrodes are ready to be connected to an external load. When photons of light fall on the cell, they transfer their energy to the charge carriers. The electric field across the junction separates photo-generated positive charge carriers (holes). From their negative counterpart (electrons). In this way an electrical current is extracted once the circuit is closed on an external load.

2.2 Motor:

The Brushless DC (BLDC) motor is used as the drive motor for the vehicle. It‟s a permanent magnet square wave motor. BLDC motor uses feedback directly of the rotor angular position so that the input armature current can be switched among the motor phases in exact synchronization with the rotor motion..The reason for opting for the BLDC motor is because of its efficiency, noiseless operation, dynamic response and high torque to weight ratio. Brushless DC electric motor (BLDC motors, BL motors) also known as electronically commutated motors (ECMs, EC motors) are synchronous motors that are powered by a DC electric source via an integrated inverter/switching power supply, which produces an AC electric signal to drive the motor in this context, AC, alternating current, does not imply a sinusoidal waveform, but rather a bi-directional current with no restriction on waveform. Additional sensors and electronics control the inverter output amplitude and waveform (and therefore percent of DC bus usage/efficiency) and frequency (i.e. rotor speed). The rotor part of a brushless motor is often a permanent magnet synchronous motor, but can also be a switched reluctance motor, or induction motor.

2.3 Lead acid battery:

Lead acid batteries are one of the most popular types of battery in electronics. Although slightly lower in energy density than lithium metal, lead acid is safe, provided certain precautions are met when charging and discharging. This have a many advantages over other conventional types of batteries, the lead acid battery is the optimum choice for a solar assisted bicycle. Current supplied from battery indicates the flow of energy from the battery and is measured in amperes (or Amps) . The higher the current flow faster the battery will discharge. A battery is rated in ampere-hours (abbreviated Ah) and this is called the battery capacity. This project revolves around supplying and utilizing energy within a high voltage battery. It demands for a battery with longer running hours, lighter weight with respect to its high output voltage and higher energy density. Among all the existing rechargeable battery systems, the lead acid cell technology is the most efficient and practical choice for the desired application. The battery chosen for this project was a high capacity lead acid battery pack designed specifically for vehicles. Plastic casing is provided to house the internal components of the battery.

2.4 Tilt sensor:

Tilt sensors allow you to detect orientation or inclination. They are small, inexpensive, low power and easy-to-use. If used properly, they will not wear out. Their simplicity makes them popular for toys, gadgets and appliances. Sometimes they are referred to as "mercury switches", "tilt switches" or "rolling ball sensors" for obvious reasons. They are usually made by a cavity of some sort (cylindrical is popular, although not always) and a conductive free mass inside, such as a blob of mercury or rolling ball. One end of the cavity has two conductive elements (poles).

2.5 Motor driver (H bridge) :

The L298 is an integrated monolithic circuit in a 15-lead Multi watt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input signals. The emitters of the lower transistors of each bridge are connected together and the corresponding external terminal can be used for the connection of an external sensing resistor. An additional supply input is provided so that the logic works at a lower voltage.

2.6 Microcontroller:

Microprocessors and microcontrollers are widely used in embedded systems products. Microcontroller is a programmable device. A microcontroller has a CPU in addition to a fixed amount of RAM, ROM, I/O ports and a timer embedded all on a single chip. The fixed amount of on-chip ROM, RAM and number of I/O ports in microcontrollers makes them ideal for many applications in which cost and space are critical. The Intel 8052 is Harvard architecture, single chip microcontroller (µC) which was developed by Intel in 1980 for use in embedded systems. It was popular in the 1980s and early 1990s, but today it has largely been superseded by a vast range of enhanced devices with 8052-compatible processor cores that are manufactured by more than 20 independent manufacturers including Atmel, Infineon Technologies and Maxim Integrated Products. 8052 is an 8-bit processor, meaning that the CPU can work on only 8 bits of data at a time.

III. FORMULEAS TO DESIGN SOLAR TRAVELER

3.1 .Calculating Mechanical Power Requirements:

In dc motors, electrical power (P_{el}) is converted to mechanical power (P_{mech}). In addition to frictional losses, there are power losses in Joules/sec (Iron losses in coreless dc motors are negligible).

$$P_{el} = P_{mech} + P_{j\ loss}$$

Physically, power is defined as the rate of doing work. For linear motion, power is the product of force multiplied by the distance per unit time. In the case of rotational motion, the analogous calculation for power is the product of torque multiplied by the rotational distance per unit time.

$$P_{rot} = M \times \omega$$

Where:
P_{rot} = rotational mechanical power
M = torque
ω = angular velocity

The most commonly used unit for angular velocity is rev/min (RPM). In calculating rotational power, it is necessary to convert the velocity to units of rad/sec. This is accomplished by simply multiplying the velocity in RPM by the constant (2 x Π) /60:

$$\omega_{rad} = \omega_{rpm} \text{ x } (2\Pi)/60$$

It is important to consider the units involved when making the power calculation. A reference that provides conversion tables is very helpful for this purpose. Such a reference is used to convert the torque-speed product to units of power (Watts). Conversion factors for commonly used torque and speed units are given in the following table. These factors include the conversion from RPM to rad/sec where applicable. For example, assume that it is necessary to determine the power required to drive a torque load of 3 oz-in at a speed of 500 RPM. The product of the torque, speed, and the appropriate conversion factor from the table is:

$$3\text{oz-in x } 500\text{rpm x } 0.00074 = 1.11 \text{ Watts}$$

Calculation of power requirements is often used as a preliminary step in motor or gear motor selection. If the mechanical power required for a given application is known, then the maximum or continuous power ratings for various motors can be examined to determine which motors are possible candidates for use in the application.

3.2. Numerical Calculation:

For an iron-less core, DC motor of relatively small size, the relationships that govern the behavior of the motor in various circumstances can be derived from physical laws and characteristics of the motors themselves. Kirchoff's voltage rule states, "The sum of the potential increases in a circuit loop must equal the sum of the potential decreases." When applied to a DC motor connected in series with a DC power source, Kirchoff's voltage rule can be expressed as "The nominal supply voltage from the power source must be equal in magnitude to the sum of the voltage drop across the resistance of the armature windings and the back EMF generated by the motor.":

$$V_0 = (I \text{ x } R) + Ve \text{ ue Units}$$

Where:
V_o = Power supply (Volts)
I = Current (A)
R = Terminal Resistance (Ohms)
V_e = Back EMF (Volts)

The back EMF generated by the motor is directly proportional to the angular velocity of the motor. The proportionality constant is the back EMF constant of the motor.

$$V_e = \omega \text{ x } Ke$$

Where:
ω= angular velocity of the motor
k_e = back EMF constant of the motor
Therefore, by substitution:
$V_o = (I \text{ x } R) + (\omega \text{ x } K_e)$

The back EMF constant of the motor is usually specified by the motor manufacturer in volts/ RPM or mV/RPM. In order to arrive at a meaningful value for the back EMF, it is necessary to specify the motor velocity in units compatible with the specified back EMF constant. The motor constant is a function of the coil design and the strength and direction of the flux lines in the air gap. Although it can be shown that the three motor constants normally specified (back EMF constant, torque constant, and velocity constant) are equal if the proper units are used, calculation is facilitated by the specification of three constants in the commonly accepted units. The torque produced by the rotor is directly proportional to the current in the armature windings. The proportionality constant is the torque constant of the motor.

$$M_o = I \text{ x } Km$$

Where:
M_o = torque developed at rotor
k_M = motor torque constant
Substituting this relationship:

$$V = (M \text{ x } R)/Km + (\omega \text{ x } K_e)$$

The torque developed at the rotor is equal to the friction torque of the motor plus the resisting Torque due to external mechanical loading:

$$M_0 = M_l + M_f$$

Where:
M_f = motor friction torque
M_l = load torque

3.3. Sample Calculation:

Motor 1624T009S is to be operated with 9 volts applied to the motor terminals. The torque load is 0.2 oz-in. Find the resulting motor speed, motor current, efficiency, and mechanical power output. From the motor data sheet, it can be seen that the no-load speed of the motor at 12 volts is 11,700 rpm. If the torque load is not coupled to the motor shaft, the motor would run at this speed. The motor speed under load is simply the no-load speed less the reduction in speed due to the load. The proportionality constant for the relationship between motor speed and motor torque is the slope of the torque vs. speed curve, given by the motor no-load speed divided by the stall torque. In this example, the speed reduction caused by the 0.2 oz -in torque load is:
0.2 oz-in x (11,700 rpm/.634 oz-in) = -3,690 rpm

The motor speed under load must then be:

11,700 rpm - 3,690 rpm = 8,010 rpm

The motor current under load is the sum of the no-load current and the current resulting from the load. The proportionality constant relating current to torque load is the torque constant (kM), in this case, 1.039 oz -in/A. In this case, the load torque is 0.2 oz-in, and the current resulting from the load must be:

I = 0.2 oz-in x 1 amp/1.039 oz -in = 192 mA

The total motor current must be the sum of this value and the motor no-load current. The data sheet lists the motor no-load current as 60 mA. Therefore, the total current is:

192 mA + 12 mA = 204 mA

The mechanical power output of the motor is simply the product of the motor speed and the torque load with a correction factor for units (if required). Therefore, the mechanical power output of the motor in this application is: The mechanical power input to the motor is the product of the applied voltage and the total motor current in Amps. In this application:

Output power = 0.2 oz-in x 8,010 rpm x 0.00074 = 1.18 Watts
Input power = 9 volts x 0.203 A = 1.82Watts
Since efficiency is simply power out divided by power in, the efficiency in this application is:

Efficiency = 1.18 Watts / 1.82 Watts = 0.65 = 65%

3.4. Thermal Calculations:

A current I flowing through a resistance R results in a power loss as heat of I^2R. In the case of a DC motor, the product of the square of the total motor current and the armature resistance is the power loss as heat in the armature windings. For example, if the total motor current was 203 A and the armature resistance 14.5 Ohms the power lost as heat in the windings is:

Power Loss = 0.2032 x 14.5 = 0.59 Watts

The heat resulting from I2R losses in the coil is dissipated by conduction through motor components and airflow in the air gap. The ease with which this heat can be dissipated is a function of the motor type and construction. Motor manufacturers typically provide an indication of the motor’s ability to dissipate heat by providing thermal resistance values. Thermal resistance is a measure of the resistance to the passage of heat through a given thermal path. A large cross section aluminum plate would have a very low thermal resistance, for example, while the values for air or a vacuum would be considerably higher. In the case of DC motors, there is a thermal path from the motor windings to the motor case and a second between the motor case and the motor environment (ambient air, etc.). Some motor manufacturers specify a thermal resistance for each of the two thermal paths while others specify only the sum of the two as the total thermal resistance of the motor. Thermal resistance values are specified in temperature increase per unit power loss. The total I2R losses in the coil (the heat source) are multiplied by thermal resistances to determine the steady state armature temperature. The steady state temperature increase of the motor (T) is given by:

$$T_{inc} = I^2R \times (R_{th1} + R_{th2})$$

Where:
T_{inc} = temperature increase
I = current through motor windings
R = resistance of motor windings
R_{h1} = thermal resistance from windings to case
R_{h2} = thermal resistance case to ambient

For example, a 1624E009S motor running with a current of 0.203 Amps in the motor windings, with an armature resistance of 14.5 Ohms, a winding-to-case thermal resistance of 8 °C/Watt, and a case-to-ambient thermal resistance of 39 °C/Watt. The temperature increase of the windings is given by:

$$T = .2032 \times 14.5 \times (8 + 39) = 28°C$$

If it is assumed that the ambient air temperature is 22°C, then the final temperature of the motor windings is 50°C (22° + 28°). It is important to be certain that the final temperature of the windings does not exceed their rated value. In the example given above, the maximum permissible winding temperature is 100°C. Since the calculated winding temperature is only 50°C, thermal damage to the motor windings will not be a problem in this application. One could use similar calculations to answer a different kind of question. For example, an application may require that a motor run at its maximum torque without being damaged by heating. To continue with the example given above, suppose it is desired to run motor 1624E009S at the maximum possible torque with an ambient air temperature of 22°C. The designer wants to know how much torque the motor can safely provide without overheating.

The data sheet for motor 1624E009S specifies a maximum winding temperature of 100°C. Since the ambient temperature is 22°C, a rotor temperature increase of 78°C is tolerable. The total thermal resistance for the motor is 47°C/Watt. By taking the reciprocal of the thermal resistance and multiplying this value by the acceptable temperature increase, the maximum power dissipation in the motor can be calculated:

$$P = 78° \times 1 \text{ Watt}/47° = 1.66 \text{ Watts}$$

Setting I^2R equal to the maximum power dissipation and solving for I yields the maximum continuous current allowable in the motor windings:

$$I^2 = 2.19 \text{ Watts} / 14.15 \text{ ohms}$$
$$I^2R = 2.19 \text{ Watts}$$
$$I = 338 \text{ Amps}$$

The motor has a torque constant of 1.86 oz-in/A and a no-load current of 60 mA. Therefore, the maximum current available to produce useful torque is .530 Amps (.590 - .060), and the maximum usable torque available (M) is given by:

$$M = .327 \text{ A} \times 1.309 \text{ oz-in/A} = 0.428 \text{ oz-in}$$

The maximum allowable current through the motor windings could be increased by decreasing the thermal resistance of the motor. The rotor-to-case thermal resistance is primarily fixed by the motor design. The case-to-ambient thermal resistance can be decreased significantly by the addition of heat sinks. Motor thermal resistances for small DC motors are usually specified with the motor suspended in free air. Therefore, there is usually some heat sinking which results from simply mounting the motor into a framework or chassis. Some manufacturers of larger DC motors specify thermal resistance with the motor mounted into a metal plate of known dimensions and material. The preceding discussion does not take into account the change in resistance of the copper windings as a result of heating. While this change in resistance is important for larger machines, it is usually not significant for small motors and is often ignored for the sake of calculation.

IV CONCLUSION:

The solar vehicle solves many problems related to the environment and is the best pollution free method. We need to make use of them so that we can reduce our dependence on fossil fuels. Solar vehicles do have some disadvantages like small speed range, initial cost is high. Also, the rate of conversion of energy is not satisfactory (only 17%). But these disadvantages can be easily overcome by conducting further research in this area; like the problem of solar cell scan be solved by using the ultra efficient solar cells that give about 30-35% efficiency. As this field of automobiles will be explored the problems will get solved. The solar automobiles have a huge prospective market and we should start using them in our day to day life. We have already completed making a solar vehicle prototype as our project and the vehicle is running.

REFERENCES

[1] Naveen Prabhu (May 2014) , Design and Fabrication of Solar Transport Vehicle, ISSN : 2278-1684

[2] Bin Ye , Jingjing Jiang , Lixin Miao 1, Peng Yang , Ji Li and Bo Shen (2015) Feasibility Study of a Solar-Powered Electric Vehicle Charging Station Model

[3] Nusrat Chowdhury , Chowdhury Akram Hossain , Michela Longo 3and Wahiba Yaïci (2018) Optimization of Solar Energy System for the Electric Vehicle at University Campus in Dhaka, Bangladesh

[4] Graham S. Aikenhead(2011) Bicycle Applications for On-Board Solar Power Generation System Adaptation

[5] Amar Kumar Das, Pravukalyan Prusty, Manas Milan Saktidatta Ojha (2017) Design and Fabrication of a Solar Powered Vehicle and its Performance Evaluation.

[6] Md Meganur Rhaman1, Tanvir Ahmed Toshon(2014) Solar Powered Rickshaw (SPR) can Diminish the Physical Labor of Rickshaw Puller and Improve the Power Crisis in Bangladesh

[7] Alaa A. Shakir1, Ali Ahmed Mohammed 2012 ,Curb parking in Campus and Stimulating Students to use Public Bus within Universiti Kebangsaan Malaysia (UKM) Campus

[8] Norsyuhadah Norzalwi and Amiruddin Ismail 2011 ,Public Approach Towards Sustainable Transportation in UKM's Campus

[9] Dorina Pojani and Dominic stead 2015 , Sustainable Urban Transport In The Developing World Beyond Megacities (ISSN 2071-1050)

[10] Babrbra c Richardson , Huai Chu Huang, Brian N. Ebarvia (2000) , Toward Estimating Sustainable Transportation System Benefits Based On User Needs

[11] Robert Baertsch (2008) Solar-Powered Personal Rapid Transit (PRT): Electric Vehicles Without Batteries or Congestion