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Solar Bicycle Performance and Analysis in Andhra Pradesh

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Abstract

The state of Andhra Pradesh suffers from tremendous demand-supply mismatch in the power sector. The industries in the states have been facing the brunt of the low supply of electricity and are forced to cut production significantly. A large number of power plants in the state use natural gas as fuel and the supply of natural gas, too, has fallen significantly across India.

Anantapur to be world's top solar power producer most of the parts Andhra Pradesh state is endowed with a vast solar energy potential and having about 300 sunny days in a year. The daily solar energy incidence is between 5.5 and 6kwh/m2 at different parts of the state. In general the areas Nizamabad, Mahabubnagar, karimnagar, Adilabad, Medak, Hyderabad,Rangareddy, Guntur, Anantapur and Kadapa districts are feasible to set up solar power projects. The proposed location for setting up the 5MW power project based solar photovoltaic technology is Amudalagondi village, manadal madakasira, district anantapur; whitch is approximately around 115km north of Bangalore city. It is well connected from banglore(Karnataka) and anantapur(A.P). Solar energy presents a highly logical solution to the poor power situation in the state. The state government recently offered project developers tender to set up 1,000 MW of solar power capacity. The tender received an overwhelming response with developers offering to install up to 1,340 MW of solar power projects.

There are many types of bicycle in the world such as normal bicycle that people need to paddle for it to move, motorized bicycle that uses fuel as its prime power and electric bicycle that can only be sufficient for an hour. Because of some weaknesses in the existence system, the idea of a solar bicycle came in mind. The idea is to make the bicycle last longer and can be automatically recharge when the bicycle is not in use by the renewable solar energy. The concept of the solar energy is that a high torque motor will be put on the bicycle which will be generated by the solar energy. The solar energy will be absorbed by the portable solar panel to generate the power. The power that had been absorbed by the panel can be used directly by the motor if the power matches the power requirement. If not, the motor will use the power from a battery. When the bicycle was not in use during the day, the solar panel will charge the battery. The system will make bicycle operate more efficiently.

Keywords

Bicycle, Solar Energy, Anantapur, Solar Panel, Solar Charger

I. Introduction

This paper will discuss about the main idea of this project and to get a larger picture on what is the problem in the current technologies, what that I want to achieve in this project and the area that will cover on this project. This chapter is divided into some categories that are project background to describe the reasons to do this project, problem statement to inform about the problem or weakness of the existing technology, objective to make sure what actually this project must achieve and scope of this project to specify what will be used in this project.

There will be a big area at the university campus Anantapur when it is fully built and operates. So students need a vehicle to move from one side to another. In state of using car or motorcycle that are costly, student will be prefer to used bicycle as their vehicle. There several types of bicycle that can be chosen such as paddle bicycle, motorized bicycle and electric bicycle. But there are some weaknesses about that type of bicycle. To overcome the weakness this project will develop a better bicycle. Because of Anantapur is located in the actuator area, this project will make used the energy of the sun that rarely used in Anantapur to generate the bicycle.

II. Problem Statement

As what had been mention earlier, there are several types of bicycle that can be categories that is paddle bicycle, motorized bicycle, and electric bicycle. The weakness of the bicycle make people do not like to used bicycle. First, paddle bicycle need a lot of energy to paddle the bicycle. The user will surely be tired after used the bicycle. This will not suitable for student to use to go to the class because they will be tired when they are in the class and will lost their concentration while hearing the lecture.

Next, motorize bicycle that used fuel as it prime mover. The bicycle use fuel that is costly. As a student, their allowance is limited and only can be used for their study material and for their food to survive at the campus. Besides that, motorize bicycle will make pollution that can be very bad for our environment especially in this period that global warming happen to the earth. Lastly, electric bicycle 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 bicycle that used more energy compare to the normal bicycle because of the weight.

III. Objective

To overcome the problem and the weakness, this project need to do some research and studying to develop better technology. To make it success there are several thing that we need to know such as what will be the prime mover, how to stored it and the advantages of this new vehicle. In that case, these are the list of the objective to be conduct before continue to proceed on this project,

- To develop a vehicle that use renewable energy, environmentally friendly and heap.
- To develop an electrical bicycle that can charge the battery when it is not in used.
- To develop low speed bicycle, but for a longer distance

IV. Scope of the Project

This project is consists of two part that is hardware and software. The hardware will be the bicycle and the software is the program of the controller to control the operation of the bicycle. To be more specific about this project, there will be using several things that are.

- Use solar energy to recharge the battery.
- Use PIC Microcontroller for charging system.
- Use high torque motor to drive the bicycle.

In order to perform this project, literature review has been made from various sources like journal, books, article and others.

This chapter includes all important studies which have been done previously by other research work. It is importance to do the literature review before doing the project because we can implement if there are information that related to this project. The most important thing before starting the project we must clearly understand about the topic that we want to do. So by doing the literature review we can gain knowledge to make sure we fully understand and can complete the project.

A review of the article was performed to identify studies that relevant to the topic. The search to find material that related to the topic is categories as solar panel, solar charger, battery, motor, electric bicycle and speed control.

V. Solar Panel

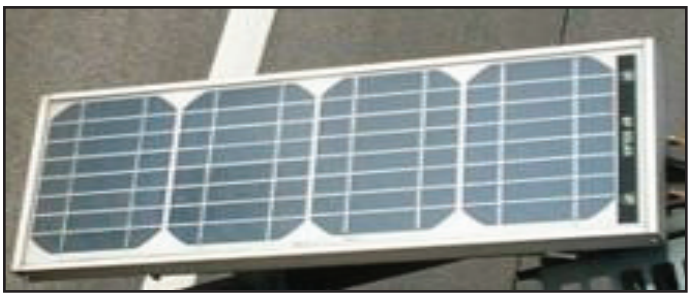

Fig. 1: Solar Panel

A photovoltaic module or photovoltaic panel is a packaged interconnected assembly of photovoltaic cells, also known as solar cells. The photovoltaic module, known more commonly as the solar panel, is then used as a component in a larger photovoltaic system to offer electricity for commercial and residential applications. The primary difficulty with solar power and indeed with its cousin wind power has been one of efficiency. There is more than enough energy hitting the earth in the form of solar radiation to meet power needs of our species. Estimates indicate that there is four times as much wind energy available for our use as the species uses every year. Solar power is even more dramatic, the sun showers the planet with more energy every day than we use in a year. So the difficulty has never been the availability of sun and wind, they are readily available.

VI. Solar Charger

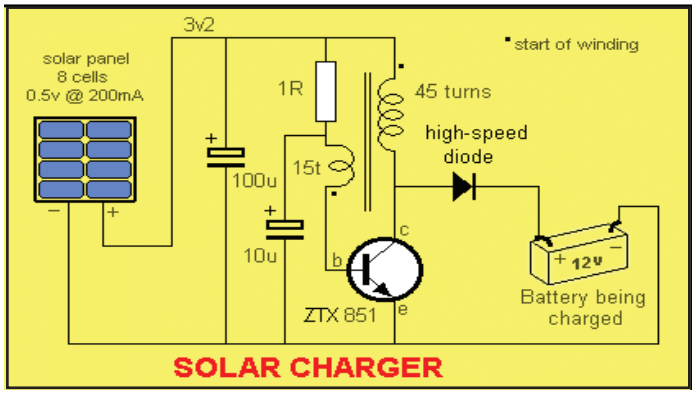

Fig. 2: Circuit Diagram for Solar Charger

Solar battery chargers are an inexpensive, environmentally friendly, and convenient way to make sure your batteries are always fully charged and ready to go all the time. The problem with charging a battery from a solar panel is the SUN. It does not shine all the time and clouds get in the way. Our eyes adjust to the variations in the strength of the sun but a solar panel behaves differently. As soon as the sun loses its intensity, the output from a solar panel drops enormously. Not only does the output current fall, but the output voltage also decreases. Many of the solar panels drop to below the 13.6v needed to charge a 12v battery and as soon as this occurs, the charging current drops to ZERO. This means they become useless as soon as the brightness of the sun goes away.

VII. Electric Bicycle

Fig. 3: Electric Bicycle

The basic configuration of an electric bicycle drive consists of a controller that controls the power flow from the battery to the electric motor. This power flow acts in parallel with the power delivered by the rider via the pedal of the bike. The rider of an E-bike can choose to rely on the motor completely, pedal and use the motor at the same time or pedal only (use as a conventional bicycle)

VIII. Design

The design involves the calculation of power required to run a bicycle at a known speed (say 20 km/h) and to develop a solar powered system to produce the required power. Since additional attachments are to be mounted on the cycle, a light weight cycle with geared system and suspension was selected. A Hero DTB Cycle was purchased.

Motor calculations

Since the total cycle weight is equal to 100 kg, the
Normal reaction acting on each tyre is equal to (50 x9.81) Newton each.

Friction force acting on the tyre

$F = \mu N1$
$F = 0.3 \times 490.5$
$F = 147.15$ N

Specified Torque=21Nm. Speed calculations:

$\omega = v \div r$, $\omega = (20 \times 1000) \div (0.33 \times 3600)$
$\omega = 16.83$ rad/sec
$\omega = (2 \pi N) \div 60$
$N = (60 \times \omega) \div (2\pi)$
$N = (60 \times 16.83) \div (2\pi)$
$N = 161$ rpm

Power calculations:

$P = (2 \pi N T) \div 60$

$P = (2 \pi \times 161 \times 21) \div 60$

$P = 353.878$ W

The solar power is used as a supplementary energy to ride the bicycle.

A motor with power of 350 W with peak wattage 388W is selected.

Battery specification:

Power = Voltage x Current $P = V.I$

$350 = 24 \times I$ $I = 14.58$Ah

Hence according to the above calculations, to drive a motor of 350 W, 24 V capacity, we select 2 batteries of 12V, 12.5Ah. We connect these batteries in series to achieve a voltage of 24V as required by the motor.

Electrical Charging:

Time required to fully charging the battery is calculated.

Power Supplied to Battery during AC Charging: AC Adapter Specification: 12V, 3 A

$P = V.I$

$P = 12 \times 3$

$P = 36$ W

Therefore the time required to charge the battery completely is:

$t = 300 \div 36$

$t = 8.5$ hours

Hence, it is found that, the time required to charge the batteries completely is 8.5 hours

IX. Solar Panel

A solar panel of 40 W capacities was selected due to space constraint. To charge the battery completely, it needs 300/ 40 = 7.5 hours are required. The solar panel is a photovoltaic converter which works in bright sunlight and in diffused sunlight .The DC voltage booster keeps the voltage optimum for the battery to get charged even while the voltage falls below threshold in diffused sunlight.

The blockage diode used in the charger prevents the reverse flow of current from the battery to solar panel

Selection of Battery: Two lead acid Battery with 12 V and 12.5 amp-hour rating are used. The selection of battery depends on its voltage, ampere and wattage rating etc. The total power of fully charged battery in 8.5 hours is 300 Watt-hours.

Selection of Motor: A Brushless D C Hub Motor (BLDC) motor for 350 Watts power with electronic commutation system is selected. Brushless DC Motors (BLDC) have many preferred compared to mechanically commuted DC motors because BLDC motors have permanent magnet, electronically commuted, No winding on rotors, frictionless operation, less noise and more uniform torque.

X. Electrical Accelerator

An electrical signal accelerator works on the principle of Hall Affect generator, which produces speed controlling signals based on the rotation of the actuator.

Assembly of solar panel and power transmission system

The fabrication process involves fixing the different components to the frame of the bicycle. The motor is fixed to the rear wheel shaft with proper alignment so that the weights are perfectly balanced. A battery casing in which 2 Pb batteries of 12V, 12.5Ah are fixed to frame and wirings are drawn from battery to motor so as to transmit power from battery to motor. Also wiring for speed control is also incorporated. The solar panel is mounted on top of battery casing and cycle carrier. A DC voltage booster is placed below solar panel. Appropriate wiring is done to charge the battery through a jack for AC charging. This makes it possible to charge the battery either by solar power or by electrical charging. The speed controller mounted in the center of cycle cuts off the power supply to the motor and stops it The same brake stops the cycle with conventional friction brake. The braking system stops motor as well as cycle simultaneously.

XI. Results and Discussion

The cycle was placed in sun light and was found that it requires 7.5 hours for fully charging the battery. But with electrical charging it needs 8.5 hours. The discharge time of battery theoretically is 1 hour. But it was observed that the discharge time of battery is 50 minutes and discharge takes place exponentially. The cycle was tested on plain flat road and a maximum speed of 15 Kmph (fig. 5) could be obtained without pedalling.

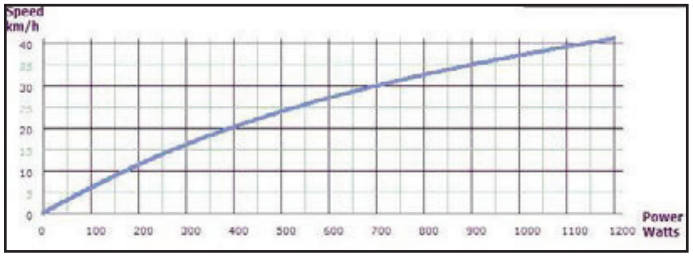

Fig. 5: Speed Vs Power on a flat Horizontal Road

XII. Conclusion

The solar powered bicycle has the following salient features. A cycle can run at an average speed of 15 kmph (without pedalling) with a maximum of 25 kmph with pedalling. The battery can be charged in dual mode, Solar or Electrical supply. The battery can be charged in rainy season or at nights also. The cost is less (Rs 20,000/-) compared to Luna (Rs 37000 /-) or E – Bike (Rs 30000 and above). Eco - friendly, No Pollution. The battery is being charged while riding in sun. Hence charging and usage takes place simultaneously. No running cost. It can be easily recommended as a local vehicle

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