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SOLAR BICYCLE - An Initiative Towards Conservation of Non-Renewable Resources

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Abstract:

The energy prices throughout the world kept increasing.Hence There is a need for new alternatives in order to overcome the issue of rising prices. So, We have come up with the concept of a solar bike that would turn out to be the possible solution to the increasing prices. Moreover, putting this to best use would result in the conservation of fossil fuels. A solar bike is an electric vehicle that works by converting solar energy to electrical energy to charge the battery and the stored energy in the battery helps in running the motor.

Solar bikes are veritably friendly in India. Solar bicycles will use both the solar and electrical energies to charge batteries .

We can hence make use of renewable resources to generate electricity. Solar bikes can be the future of the Nation as they are eco-friendly and do not cause any kind of pollution.

1.Introduction

Transportation plays a major role world wide today. When compared to the cost of driving a car or riding a motorcycle, people will opt to ride a bicycle. There are many different types of bicycles to choose from, including paddle bicycles, motorized bicycles, and electric bicycles. However, there are several drawbacks to this model of bicycle. This project will design a better bicycle to address the flaw. This project will require us to conduct some research and study in order to build better technology in order to overcome the difficulty and weaknesses. To make it a success, we have to know many things,like how to store it,what will be the prime mover used and the benefits of the vehicle.In that scenario, below is a list of the objectives that must be completed before moving on further.

- To create a car that runs on renewable energy that is both ecologically benign and affordable.
- Creating an electric bicycle with the ability to get charged itself using solar
- To create a bicycle
- that can run longer.

2.Literature review

A photovoltaic module, also called a solar cell, is a packed, interconnected assembly of photovoltaic cells. The photovoltaic module is then used as part of a photovoltaic system to provide energy for business and domestic uses .

The fundamental issue with solar power, as well as wind power, has been their efficiency. There is more than enough energy in the form of solar radiation striking the earth to supply our species' power requirements.. As per estimations, there is four times as much wind energy accessible to us than what the species consumes each year.

The problem has never been a lack of sunlight or wind; both are readily available.

In today's market, lead-acid batteries are the only realistic option for electric bicycle conversion. The parameters for choosing an electric car battery are listed below.

- Voltage
- Discharge Rate
- Energy density
- Watt-hour rating
- Amp-hour rating
- Cycle-life

The motor required for the Hybrid Bicycle was chosen with the assumption that extraneous factors such as wind drag, tyre rolling resistance, and so on were ignored. The thing is on the conversion of kinetic/potential energy to electrical energy .

To start the cycle from its initial position, adequate torque must be produced, which necessitates the motor drawing a significant quantity of electricity.If the ground is flat then it will not have potential energy for the motor to provide a counter torque to counteract gravities. As a result, we simply consider the kinetic energy necessary for acceleration. Equations have been used to provide the energy connections.

An electric bicycle driver's fundamental configuration is a controller that regulates the flow of the power from the battery to the electric motor. This power inflow works in tandem with the power produced by the rider through the bike's pedals. The rider of an E-bike has the option of relying either on the motor or pedaling. We can also use the motor at the same time, or pedaling exclusively.

Based on the system's measurement results, and the characteristics of the dc motor, it is believed that we would be able to manage the dc motor's speed reliably and efficiently . In normal circumstances, the dc motor in this system is powered by a change of transmission, and as the speed of the motor lowers due to overload, the load induction unit works automatically to accelerate it to the system's maximum efficiency. As a result, the dc motor's speed can be controlled.

3 Block diagram description

The Hybrid Bicycle's construction approach is depicted as a block diagram.(shown in below figure) The project's major goal was to ensure that the Hybrid Bicycle ran efficiently by meeting the drive specifications. Maximum speed of the vehicle can be estimated up to 23kmph,based on legal restrictions for electric bicycles. Because re-generation is involved, identifying the type of components to be used , where given the size and weight limits, has become much more important. The following are the essential components needed for this project.

- Motor
- Solar Cell
- Battery
- Frame
- Throttle
- DC-DC Boost Convertor

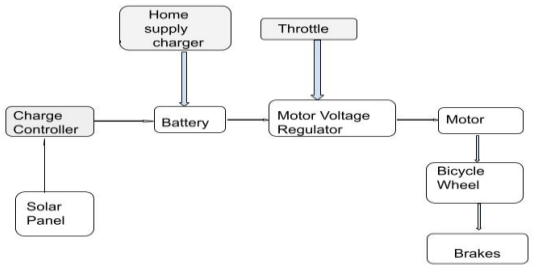

fig 1: Block Diagram

4 Methodology

4.1 Selection of components

a.Motor Selection

For the following reasons, a 250 watt permanent magnet DC motor was chosen:

- Exceptional power-to-weight ratio
- This motor is capable of delivering the system required torque.
- Furthermore,permanent magnet motors are less expensive than brushless motors and may be simply integrated into current bicycle systems.
- Because the motor speed is determined by voltage, the motor voltage rating was also critical. The motor will provide more power if the voltage rating is high.

The accurate voltage also helps to minimize

, which can help to keep the heating effects to a minimum.Speed and torque have a trade-off, as shown by equation

$$P=T\times RPM \quad (1)$$

A 24 V motor was chosen after considering all of the above factors. It was picked since it was the most popular electric bicycle model and fit with our system's objectives. The specifications for the motor are listed below.

- 250 Watt motor
- 3300 RPM
- 4.5 in x 5.5 in
- Peak ratings (intermittent duty)
- 24 V x 7 Amp continuous rating

fig 2: PMDC motor

Load value	voltage(in volts)	current (in amperes)	power(in watts)
At no load	12.1V	3.01Amp	36 watts
At full load	12.1V	7.01Amp	84 watts

Table 1: power consumption of Motor

b.Battery Selection

Cost, energy density, durability and the number of recharge cycles were the most important factors to consider while choosing batteries. Because of their inexpensive cost and reasonable energy density, sealed lead acid batteries are commonly used. After looking at a variety of electric bike designs or models, we discovered that the majority of them used three 12V batteries with their capacities ranging from 7 to 20 amp-hours. Three 12V, 7.5 amp-hours. SMFB i.e Sealed Maintenance Free Batteries , which are rechargeable lead-acid batteries, are also proposed for use in this Hybrid Bicycle project. The internal components of the battery are housed in a plastic case.

fig 3:Batteries

c.Solar Panel Selection

Using the photovoltaic effect, solar cells convert the energy from the sun directly into electricity. The following specifications of the solar panel that will be used here in this project.

fig 4: solar panel

Parameters	Values
max. rated power	25W
OC Voltage	21.4V
SC Current	1.53 Amp
Rated voltage	17.55V
Rated Current	1.12 Amp
Life span	15 years

Table 2 : Specification of solar panel

d.Charge Controller

Before the voltage from the solar panel is transferred to the batter, it is necessary to regulate it. A charge controller is a power converter.

fig 5: charge controller

Parameters	Value
Rating of the controller	4A,12.1V
Max.solar panel voltage	25.1V
Low voltage disconnect	11.5V
Boost voltage	14.29V
Battery type	12v lead acid
Consumption	less than 19.99ma
Efficiency	>76%

Table 3:Specifications of solar charge controller

e.Voltage Regulator

The level of voltage is controlled by the voltage regulator according to the requirements. This voltage regulator behaves as a tap changing switch. Two voltage levels are made use in our project. Regulator voltage levels can be modified as needed.

f.Brakes

A bicycle brake is a device that either slows down or to stop a bicycle. The arms on the other hand, are longer, with the cable housing on one arm and the cable on the other. The arms are brought together when the cable pulls against the housing. The flexible housing is extended by a rigid-tube with 90 degree bend known as the "noodle" since the housing enters vertically above one arm yet force must be delivered laterally between arms. The noodle is held in place by a stirrup that is linked to the arm. The exposed cable is frequently covered with a flexible bellows.

fig 6: Brake set

4.2 Working principle

Solar Hybrid Cycle works on the basic principle that combines the solar energy and the dynamo that moves the pedal of the cycle. There is a huge need for an alternative inorder to overcome the issue of rising prices. So, We have come up with the concept of a solar bicycle that would turn out to be the possible solution to the increasing prices. Moreover, putting this to best use would result in the conservation of fossil fuels.

4.3 Fabrication

Initially, the DC motor is connected to the free wheel through chain drive, which is then fitted on seat stays through bolts,nuts. The fabrication is done in such a way that the motor will be able to withstand the maximum load.

Grinding of edges is done in order to supply smooth surface

Measurements of Components

s.no	specification	size	weight
1	Motor	L=160mm,shaft diameter=6mm	2.5 kg
2	Battery	LxBxH =150x60x90	2kg
3	Solar Panel	LxBxH =60x40x5	1.5kg

Table 4: Measurements of Components

4.4 Assembly of Components

a.Motor Assembly

We installed the motor on the hind wheel of the bicycle by chain. The bicycle rim diameter 0.52m. To connect the motor to the hub of the wheel, we had to make some

adjustments of the motor to fit the bicycle through the chain.

b.Battery Assembly

The batteries have to fit them in a way that balancing doesn't get disturbed, so we decided to put them on the back rack of the bicycle . We made a box for carrying the batteries and for providing side support we made side covers.

c.Throttle Arrangement

The throttle is fixed on the right side of the handlebar and the controller is connected to it. The throttle converts DC voltage from battery to an alternate voltage.

d.Solar Panel Arrangement

A solar panel is made of photovoltaic cells. We used two solar panels for this project. Solar panels are placed in the front part of the cycle with the support of the front frame along with the front fender. In Order to balance the weight and to maintain balance panels are placed in the front side.

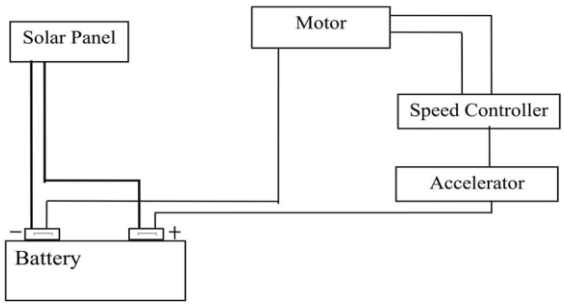

fig 7:Connection of Components

5.Theoretical calculations

5.1 Parameters

Diameter of the wheel (D) = 650mm
= 65cm

Motor details

Motor capacity	250W 24V
Motor RPM	3,300 RPM
Reduction Ratio	9:78

Diameter of motor shaft (free wheel) =30mm =30cm

Diameter of motor to cycle (free wheel) =50mm =50cm

Assumption ratio 3:5

Weight of the bicycle= 40 kg

Weight of the rider= 70 kg

5.2 Power Calculations

1) Normal-reaction on each tyre (N) = W/2

W=Wc+Wp

Wc=40kg , Wp=70kg

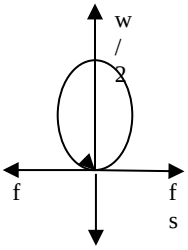

fig 8: Direction of force

40kg+70kg=110

= 110/2= 55kg

N= mg

Since g=9.81m / s2

55*9.81

N= 538.55N

2) Frictional-Force acting on single tyre (F)

In case of Static-Friction

=u*N= 0.03*538.55 (u= 0.03)

= 16.1565 N

In case of dynamic friction (u=0.003)

f= u*N

f= 0.003*538.55= 1.61565 N

In case of static-Friction

Torque (T)= f*R

= 16.1565*0.305

= 4.9277~5 Nm

In case of dynamic Friction

T=f*R

= 1.61565*0.305

= 0.492 Nm

5.3 Speed calculations

Tangential Speed w = v/R

=15000/(0.305*3600) =13.67 rad/sec

Power requirement (p)

i) Plain ground

In case of dynamic Friction

P=T*w

= 9 watt

In case of static friction

P=T*w

= 68.35 watt

Total power requirement

68.35+9watt

= 77.35 watt

ii) Inclined Surface

a=2'

Total force required to move the cycle

F=u*mg*cos(a) + mgsin(a)

F=70.013N

So, the power required =F*v

= 291.72W

additional power required =291.72-136.7

=155.02W

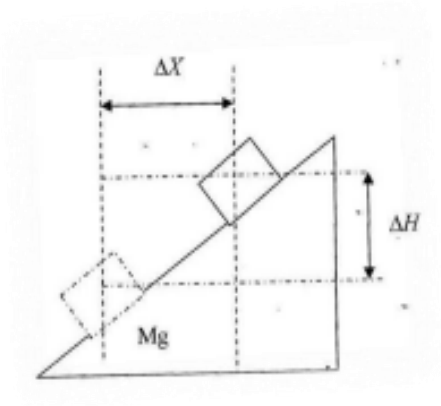

fig 9: model on inclined plane

B] Taking considerations of Dynamic friction

F=0.004*110*9.81*cos(2) +9.81*sin(2)

F=41.97N

Power(P) = F*v

174.611W

Aspects of Wind

For a flat plate that is vertical to the apparent wind, the air drag is low. When the panels are pitched by merely a degree or two, however, the force is significantly increased. Moreover, we've got two hamstrung aircraft bodies that will generate lift. This lift will make the cycle because it will act at a vector that is vertical to the apparent wind, not vertical to the face of the solar panels. It will also produce convinced drag that is proportional to the lift generated, in addition to the form drag generated by the panels projected anterior area.

5.4 Charging time

The 24V motor is selected hence the battery voltage rating should also be 24. We select two batteries of 12V and 7.5 Ah in series combination and we get 24 V and 7.5 Ah.

Time taken to charge the battery by adapter =12 V 7.5Ah

P= 12* 7.5

= 90 w

T=(24*12 / 90

= 3.2 hrs.

By using solar panel

T=(24*7.5) /25

= 3.6 hrs *2

=7.2hrs

The acceleration of a bicycle does not remain constant with respect to time. The acceleration requirement is different at different conditions, such as at starting time, at leveled roads, at inclined roads etc. Based on the bicycles available we have found the acceleration requirement at different time and in different conditions, which are described in the table below:

Table 5: Power requirements for various accelerations

Time required to accelerate (s)	Voltage	Mass	Power absorbed(watt)
5	24V	110Kg	51.796W
25	24V	110Kg	77.35W
35	24V	110kg	291.72W

6.Results and Discussions

Parameters	Hybrid bicycle	Electric bike	normal bicycle
4	10-15	25-30	5-10
Drivers pedaling requirement	May/May not be required	No	Yes
Initial unit cost in IndianRupees	12000	28000	6000
Weight in kilograms	26	40	16
Maximum traveling distance in kilometers	24	60	-
Types of energy	Electric and human power	Electric	human power
Driving Noise in (db)	5-9	64-75	No Noise
Charging time	2 hours by charger,7 hours by solar panel	3 hours	Not required
Life of battery	3-4 Yrs	3 Yrs	-
Amount to spend for each km	1.5	4	-

fig 11: Prototype

6.1Advantages

- Solar bicycles will have a good lifespan of minimum 15 years.
- Maintenance cost of this bicycle is low.
- Pedaling in the absence of [power assistant is possible .
- Thumb throttle which is simple to operate.
- The cost of a unit is very low.
- Subsidiary from The Government of India

6.2 Disadvantages

- With the increase in demand from customers the price of motor, battery, and solar panels increases.
- frictional Losses due to friction in chains and wheels.

6.3 Applications

- This bicycle can be used for transport purposes.
- Bicycles can be modified as per the requirements.

7.Conclusion

Solar bicycles are advancements of existing bicycles.

This project on Hybrid Bicycles aims at energy conservation.

Solar bicycles are suitable for both city and country roads .This bicycle is easier and cheaper at 15000 rupees.It can be used for shorter distances.

It is very much useful for children and elder people to travel for shorter distances.

It is advantageous to the environment compared to petrol vehicles.It also does not make any noise and is easily adaptable by people.

9.Reference

[1] Vivek V Kumar1, Karthik A, Ajmal Roshan, Akhil J Kumar, "Design and Implementation of Electric Assisted Bicycle with Self Recharging Mechanism", Volume 3, Special Issue 5, July 2014, International Conference On Innovations & Advances in Science, Engineering And Technology [IC - IASET 2014]
[2] Veronique Lamy," ELECTRIC BIKE 2000 PROJECT", Centre for Electric Vehicle Experimentation in Quebec (CEVEQ), april 2001.
[3] Veronique Lamy," ELECTRIC BIKE 2000 PROJECT", Centre for Electric Vehicle Experimentation in Quebec (CEVEQ), april 2001.
[4] Ajit B. Bachche, N. S. Hanamapure, "Design and Development of Solar Assisted Bicycles", International Journal of Engineering and Innovative Technol
gy (IJEIT) Volume 2, Issue 6, December 2012.
[5] T.Bhavani, K.Santhosh kumar, K.Dhiraj kumar," Novel Design of Solar Electric Bicycle with Pedal Assistance", ISSN No: 2348-4845 International Journal & Magazine of Engineering, Technology, Management and Research
[6] Mayur Parmar, Rushi Trivedi, Santosh Nair, Vikit Vora," Solar Powered E-Bike", Imperial Journal of Interdisciplinary Research (IJIR) Vol-2, Issue-5, 2016 ISSN: 2454-1362.
[7]. Robin Hardy, "Electric and hybrid vehicles", CRC Press, 2003
[8]. Mehrdad Ehsani, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design",
CRC Press, 2004.
[9]. Ajay Babu, "Preliminary Design and Simulation of Hybrid Bicycle with Fuzzy Control Approach," M.Tech thesis,
Dept. of Electrical Engg., College of Engineering, Thiruvananthapuram, 2006.
[10] http://en.wikipedia.org/wiki/Solar_vehicle
[11] http://gotwind.org/diy/solar_electric_bicycle_project.html
[12] www.nycewheels.com/solar-powered-electric-bike
[13]http://www.builtitsolar.com/Projects/Vehicles/KevinEBike.htm
[14] http://ipindiaservices.gov.in/patentsearch/search/index.aspx